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DELETED VERSION ONLY

OPERATION REDWING

A PRELIMINARY REPORT

[redacted] OF (TEWA)

Submitted by Task Group 7.1

[redacted]

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3 October 1956

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[redacted] (TEWA)

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[redacted]

[redacted]

BIKINI OBSERVED WEATHER FOR 21 JULY 1956
TEWA SHOT TIME 0546M

Sea Level Pressure	1009.3 mbs
Free Air Surface Temperature	82° F
Wet Bulb Temperature	78° F
Dew Point Temperature	77° F
Relative Humidity	85 %
Sea Water Temperature	84° F
Surface Wind	ESE 8 knots
Visibility	Over 10 miles
Weather	No showers reported

CLOUDS:

2/10 cumulus, bases at 2,000 ft.
1/10 cirrostratus, based at 30,000 ft.

STATE OF SEA:

Open Sea: Wave heights 3 ft., period 6 seconds, direction 090°.

AREA WEATHER SUMMARY FROM AIRCRAFT:

Scattered cumulus clouds bases at 2,000 ft. 4-5/8 cirros based at 35,000 ft., tops at 36,000 ft.

[redacted]

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BIKINI UPPER AIR SOUNDING:

Pressure (Millibars)	Height (Feet)	Temperature (°C)	Dew Point (°C)
1000	310	26.5	22.5
850	4950	17.8	11.5
700	10310	7.5	0.8
645	12500	3.5	-2.5
616	13747	2.2	-10.5
596	14600	0.5	-7.2
582	15223	-0.8	-16.5
500	19140	-8.5	-15.2
400	24710	-18.5	-32.8
318	30052	-31.2	-43.2
300	31540	-34.5	M
250	35640	-44.9	M
200	40240	-57.0	M
150	46010	-70.8	M
110	51929	-78.0	M

BIKINI WINDS ALOFT:

Height (Feet)	Direction (Degrees)	Velocity (Knots)	Height (Feet)	Direction (Degrees)	Velocity (Knots)
1000	080	15	26000	270	5
2000	090	15	28000	010	9
3000	110	16	30000	320	5
4000	110	16	32000	270	3
5000	110	16	34000	170	8
6000	100	17	36000	220	8
7000	100	19	38000	260	10
8000	090	20	40000	260	20
9000	090	18	45000	250	32
10000	090	17	50000	270	22
12000	090	15	55000	110	5
14000	080	14	60000	070	29
16000	120	06	65000	090	45
18000	090	11	70000	090	42
20000	130	11	75000	080	53
22000	150	8	80000	100	48
24000	070	14	85000	100	49

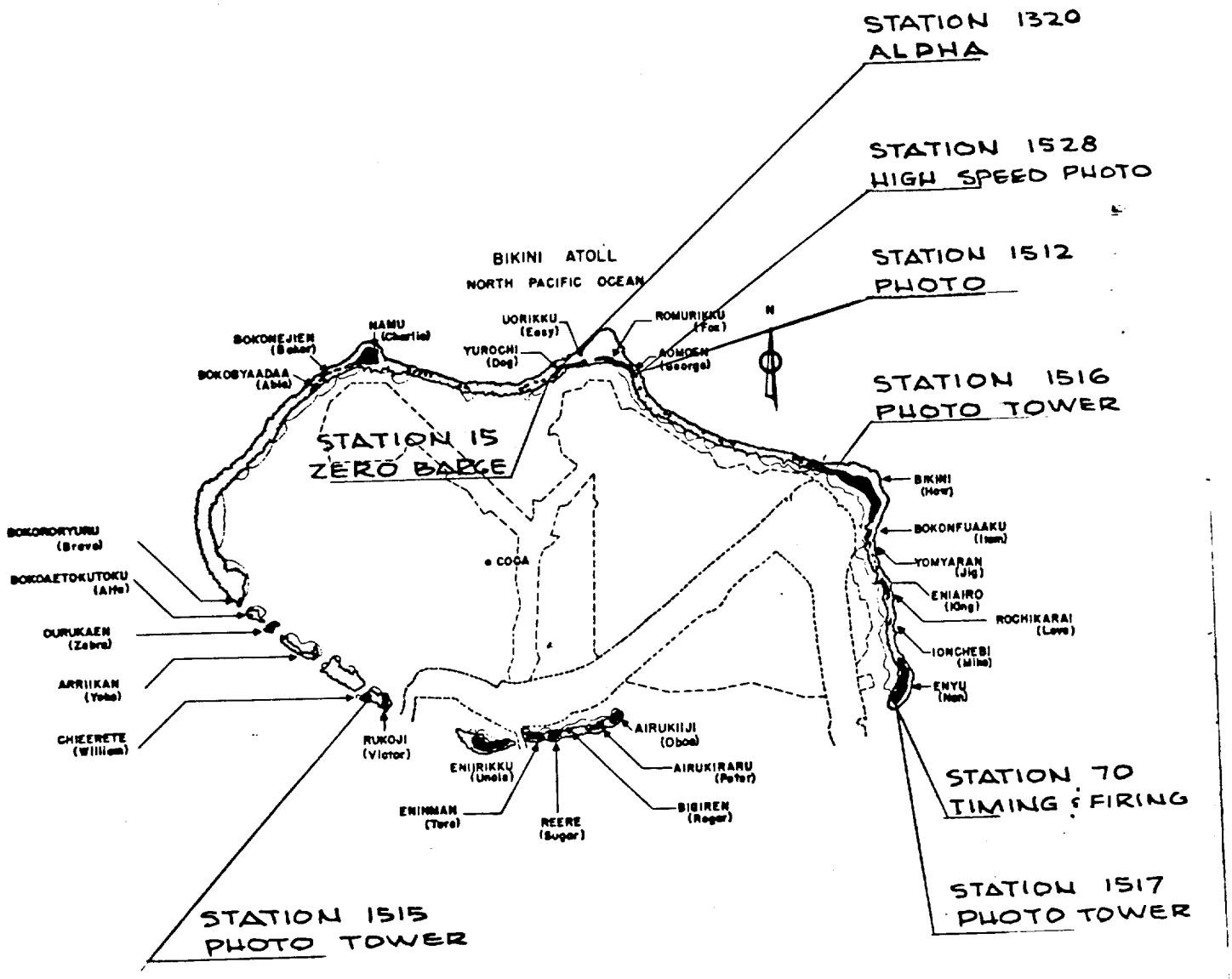

Fig. O-1 - Bikini Atoll Map

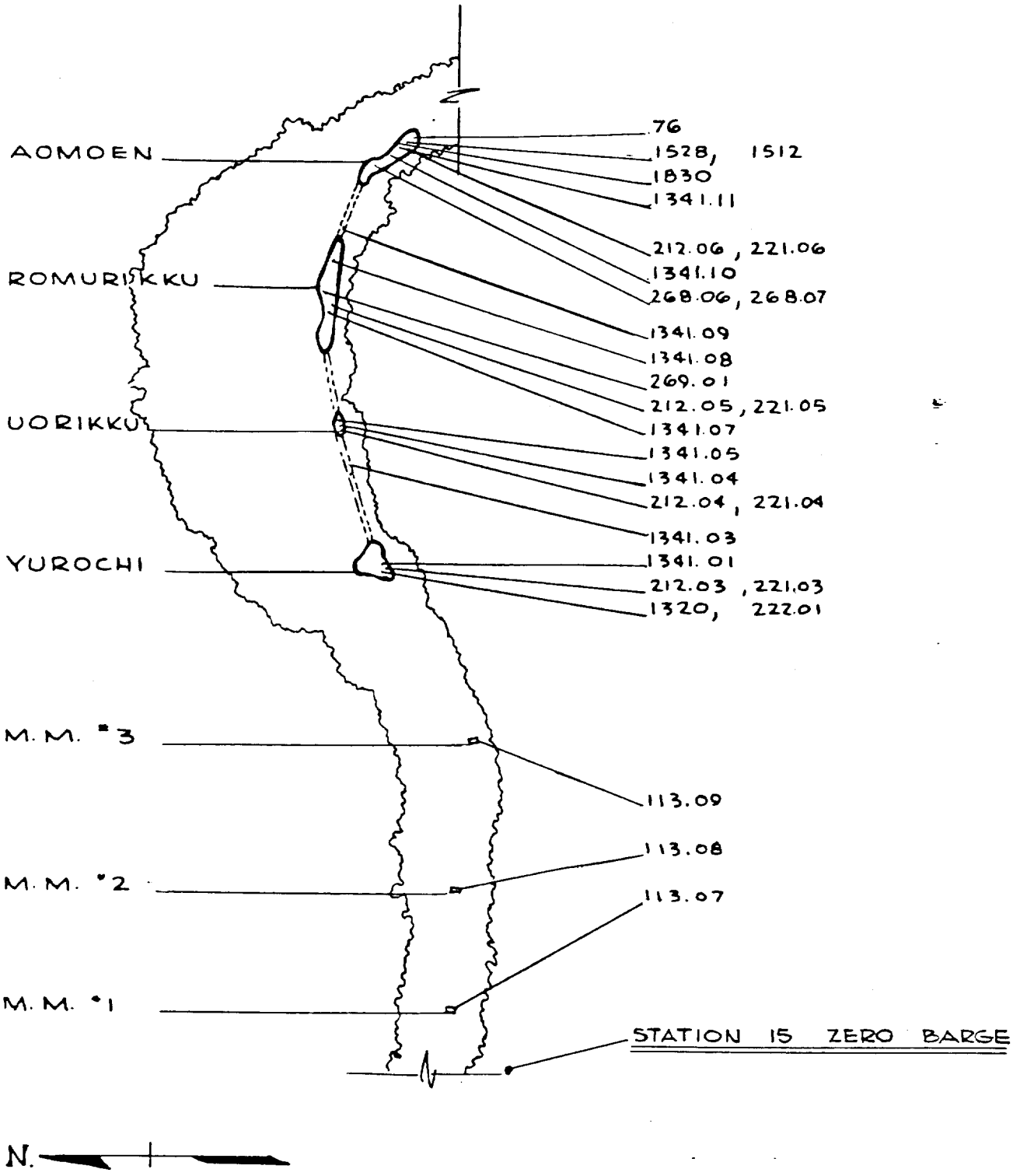

Fig. O-2 - Bikini Atoll North Reef with Scientific Stations

July 22, 1956
All Readings in mr/hr
Converted to 0800 hrs

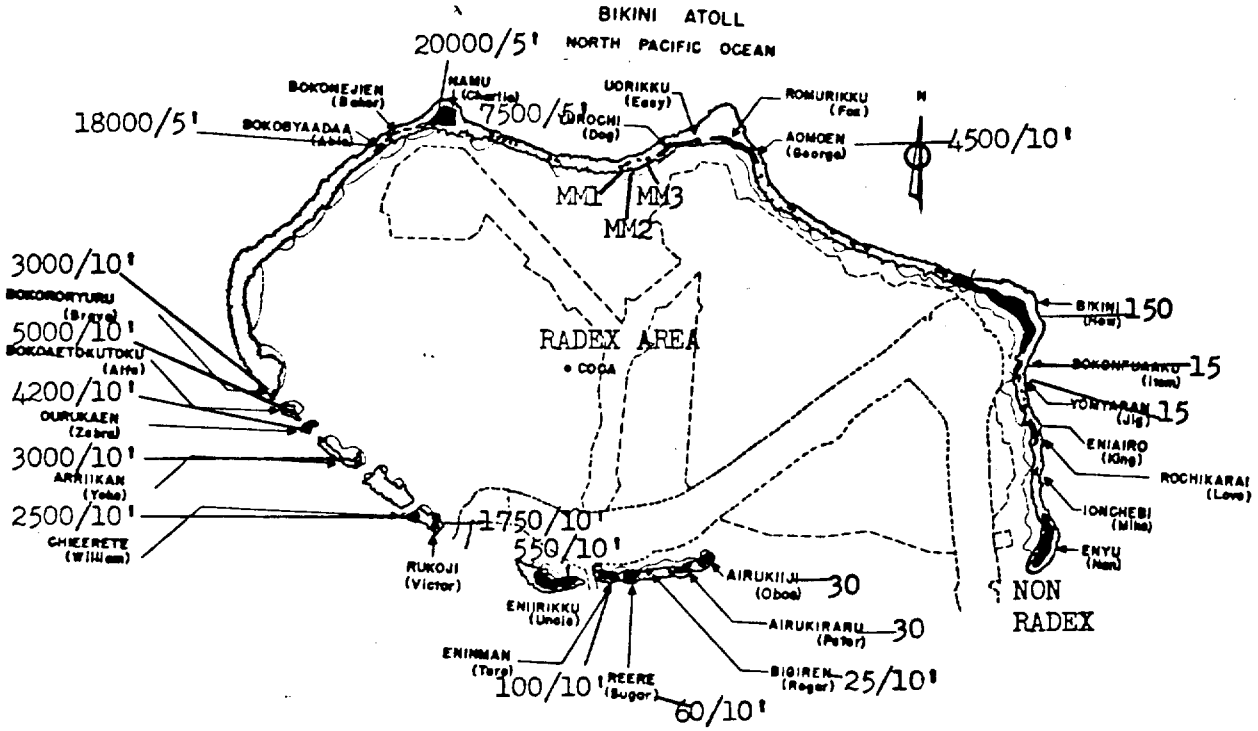

Fig. O-3 - RadSafe Survey, D+1

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23 July 1956
All Readings in mr/hr
Calculated to 0800 hrs

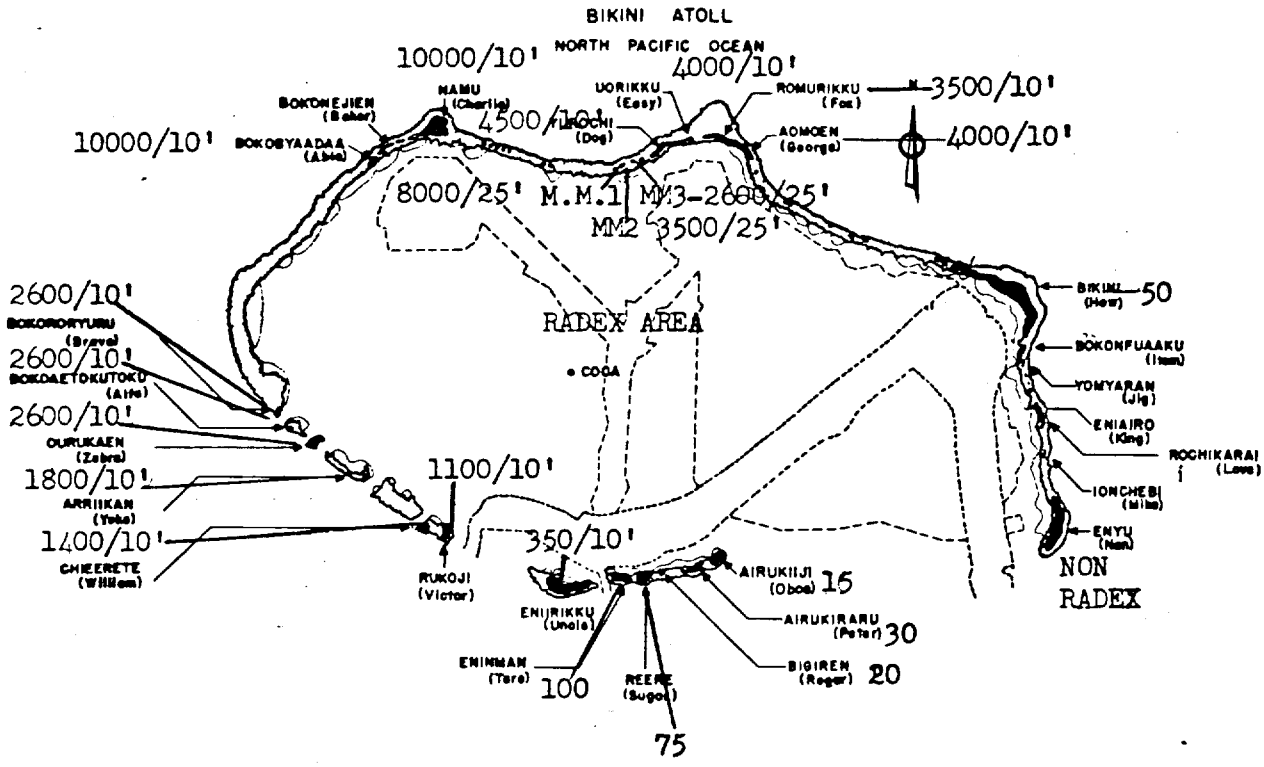

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Fig. O-4 - RadSafe Survey, D+2

PART II

TASK UNIT 3

DOD PROGRAMS

K. D. Coleman

Col. K. D. Coleman
CTU-3

Program 2 - Nuclear Radiation and Effects	CDR D. C. Campbell
Program 5 - Aircraft Structures	CDR M. R. Dahl
Program 6 - Test of Service Equipment and Materials	Lt Col C. W. Bankes
Program 9 - General Support	Lt Col J. G. James

T

[redacted] (TEWA)

Project 2.1 - Gamma Exposure Vs Distance - P. Brown

OBJECTIVE

The objective of this project was to document the initial and residual gamma exposure on Bikini Atoll using various types of dosimeters.

INSTRUMENTATION

Residual stations were located on almost every island in the Atoll. Initial stations were located on the Namu - Yurochi reef.

RESULTS

The residual information will be included in the final report. From 200 to 1000 r of residual radiation obliterated the initial gamma exposure results from the more distant reef stations. At the close stations the exposures were greater than 10^5 r causing the photographic dosimeters to saturate. Chemical dosimeters at these locations have been returned to the United States for evaluation.

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[redacted] (TEWA)

Project 2.61 - Rocket Determination of the Activity Distribution within the Stabilized Cloud - R. Soule

OBJECTIVES

Four rockets were fired at [redacted] (Tewa) in order to develop the capability of measuring and to explore the spatial distribution of gamma activity within the cloud and stem produced by the detonation of nuclear weapons of megaton yield.

INSTRUMENTATION

A six inch diameter ground launched-rocket capable of attaining 180,000 feet altitude, bearing a radiation detector and telemetering equipment was used to obtain information on the radiation field in the cloud. The first of the four rockets was fired at H + 7 minutes with the others following at ten second intervals. Radiation intensity information (in the form of F. M. pulses) was telemetered to two receiving stations where the information was recorded on magnetic tape.

RESULTS

All four rockets fired and good signal strength was received on three of the four channels. One transmitter failed shortly (about 5 seconds) after take-off and one transmitter was considerably off frequency. Accelerometers were used on two of the rockets. Their data can not be reduced in the forward area, since a discriminator will be required to separate the radiation field intensity data from the acceleration data. Data on the one channel that is readable in the forward area indicate radiation fields considerably below the average encountered from the [redacted] (Cherokee). However, they may correspond to those obtained at [redacted] (Cherokee) for a similar trajectory.

[redacted]

[redacted] (TEWA)

Project 2.62 - Fallout Studies by Oceanography Methods - F. D. Jennings

For [redacted] (Tewa), Project 2.62 conducted a fallout survey very similar to that made for the [redacted] (Navajo).

Three surface vessels, the M/V Horizon, the DE-365, and the DE-534 all remained in the fallout area for five days making measurements and collecting samples. In all, 80 water samples were taken for Project 2.63 and 80 were taken for Project 2.64.

Preliminary results show that over 30,000 square miles were contaminated such that had all the fallout occurred at H+1 hour, and if it had fallen on an infinite hypothetical plane, the dose rate at a height of 3 feet over the entire area would have exceeded 40 r/hr at that time. Several areas within this pattern would have exceeded 3,000 r/hr at H+1 hour.

There were 17 deep moor anchor stations installed for this shot and all 17 were recovered. Penetration meters had been installed on two of these skiff stations. One failed to fire, the other started and gave a good record of penetration rate. Preliminary examination indicates that fallout had penetrated to the thermocline in less than a half an hour.

[redacted]

[redacted] (TEWA)

Project 2.63 - Collection and Characterization of Fallout with Time -

T. Triffet

OBJECTIVES

To collect samples of fallout and measure radiation field intensities with time at various distances from high yield land, water and air thermonuclear detonations. To study these samples from early times with respect to gamma and beta activity, to analyze them for chemical and radiochemical composition and to determine certain of their physical properties, including distributions of particle sizes.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Two YFNB barges and three pontoon rafts were anchored in Bikini Lagoon. YFNB-29 carried two standard platforms with major arrays of instruments and YFNB-13 carried one. Each major array consisted of four open-close total collectors, two always-open total collectors, one incremental collector, one gamma intensity vs time recorder, and one wind speed and direction recorder. The arrays on the barges were fully automatic. Each pontoon raft carried an always-open total collector, a time of arrival detector and a film pack to measure total dose.

An array of 16 skiffs was deep-sea anchored by Project 2.62 between 10 and 30 miles from ground zero in the expected fallout area. Each carried a minor array.

YAG-39 was located approximately 25 miles, YAG-40 approximately 40 miles and LST-611 approximately 60 miles from ground zero; all, however, were at different azimuth angles. Each was extensively instrumented with a major array supplemented by incremental collectors and high volume filter units.

RESULTS

Approximately 90% of all project instrumentation functioned properly, and no significant damage to any station other than the one located on Namu Island was reported. Even in this case the protective cone remained upright even though crushed and a useful sample was collected. All island, barge and raft stations received fallout, as well as about half of the skiff stations; and activity levels were in general high, the highest being observed on Aomoen and Namu Islands, the YFNB-29, raft #3 and the skiffs in the northwest quadrant. Surface readings of samples collected on island, raft and barge stations averaged 2.0 r/hr at 1200 on D+1 with some as high as 5.0 r/hr at 0900 on D+2. The time of arrival of fallout was about 7 minutes at the YFNB-29 and 37 minutes at the YFNB-13.

All project ships received significant fallout, the approximate time of arrival being H+2 hours for the YAG-39, H+4.5 hours for the YAG-40 and H+7.2 hours for the LST-611. The highest activity level measured was approximately 41.0 r/hr at H+5.2 on the deck of the YAG-39, while the maximum deck intensity observed on the YAG-40 was about 7.0 r/hr at H+6.9 hours. Extrapolated to a deck condition without washdown the maximum intensity level observed on the LST-611 was approximately 1.0 r/hr. Activity measurements, decay and gamma spectra measurements, and physical observations of fallout material were performed at early times in the shielded laboratory aboard the YAG-40. The great majority of these data are being reduced at the present time. It is evident, however, that the active fallout particles were very similar to those observed following [redacted] shot of Operation Castle. These were of three general types: (1) unchanged coral particles, (2) particles with CaO or $Ca(OH)_2$ interiors and a thin $CaCO_3$ exterior shell, and (3) branch clusters, resembling agglomerated snowflakes. Early examination of a limited number of particles

indicated the flaky agglomerated type to be about twice as active as particles of the other two types with the same diameter. No significant quantity of slurry droplets, such as those observed for the [redacted] (Navajo), was found to be present.

The data obtained are being examined further and additional analyses are being performed at Naval Radiological Defense Laboratories; these results will be included in the preliminary report.

T

[redacted]

[redacted] (TEWA)

Project 2.64 - Fallout Location and Delineation by Aerial Survey -

R. Graveson

OBJECTIVES

To survey the gamma radiation from fallout contaminated ocean areas using an airborne detector.

To survey the areas of the sea, off Bikini Atoll, which are contaminated prior to shot, the information to provide both background radiation data and oceanographic studies of the mixing of the lagoon water into the open sea.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Three P2V-5 aircraft were equipped with gamma radiation detectors to record the dose rate arriving through the thin aircraft skin from the water surface below. A fourth aircraft was available on a non-interference basis with the security mission and was provided with detectors and electronics.

Two aircraft flew over the fallout area simultaneously and observed the radioactivity and altitude (operating altitude 200-400 feet). The information on radiation dose rate and altitude was continuously recorded and telemetered to the Program Two Control Center aboard the USS ESTES. There the telemetered information was correlated with the positioning data of the aircraft which was relayed over a communication channel between navigator and the project plotter.

On D-day two aircraft surveyed near the atoll when the fallout was completed. One aircraft also surveyed near the YAG-39 and YAG-40 positions before their return to base. On subsequent days the aircraft followed a

[redacted]

[redacted]

9 to 9½ hour flight plan which included surveys over the atoll as well as flights out to the end of the isodose plot (150 to 300 miles). Samples of contaminated water were obtained from Project 2.62 to measure the decay time of the radioactivity in order to extrapolate the measurements back to the fallout time.

One aircraft was to be flown over the Bikini Atoll area, and the downwind contaminated area delineated. The survey was scheduled for [redacted] (Tewa) minus 2.

RESULTS

The preshot survey found downwind contamination, as expected, with a peak intensity around 0.4 mr/hr. See attached Fig. 2.64-1.

The D-day survey was started late on D-day to avoid contamination of the aircraft. The lower outside boundary was carefully delineated. See Fig. 2.64-2 attached.

On D + 1 and D + 2, two aircraft were used to survey the contaminated area. This enclosed approximately 36,000 square miles.

On D + 3 and D + 4, one aircraft was used to follow the contaminated area in the vicinity of the hot line. This enclosed an area of approximately 2500 square miles. See Fig. 2.64-3 attached.

In summary, the aerial survey flights delineated the background contamination prior to the shot, surveyed the total contaminated area on D + 1 and D + 2, and delineated the hot area not only on D + 1 and D + 2 but followed this area on D + 3 and D + 4. The preliminary results show that this area remained relatively stable throughout this time interval.

[redacted]

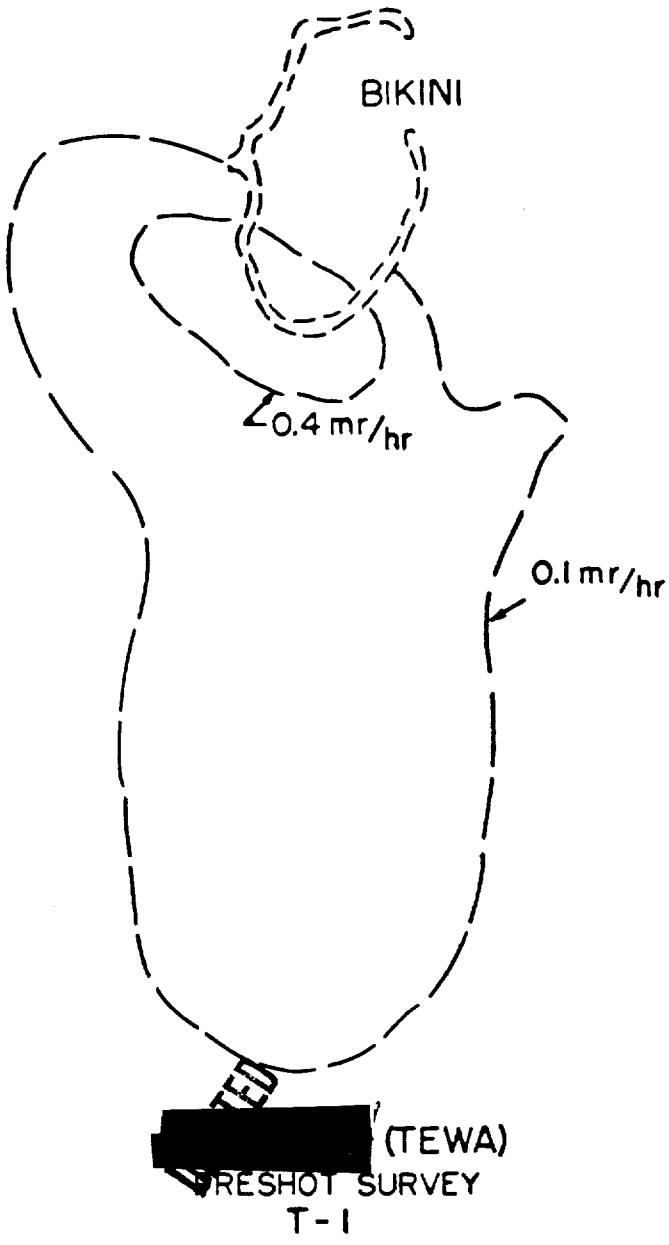

Fig. 2.64-1 - Fallout Contour Map

[redacted]

21

[redacted]

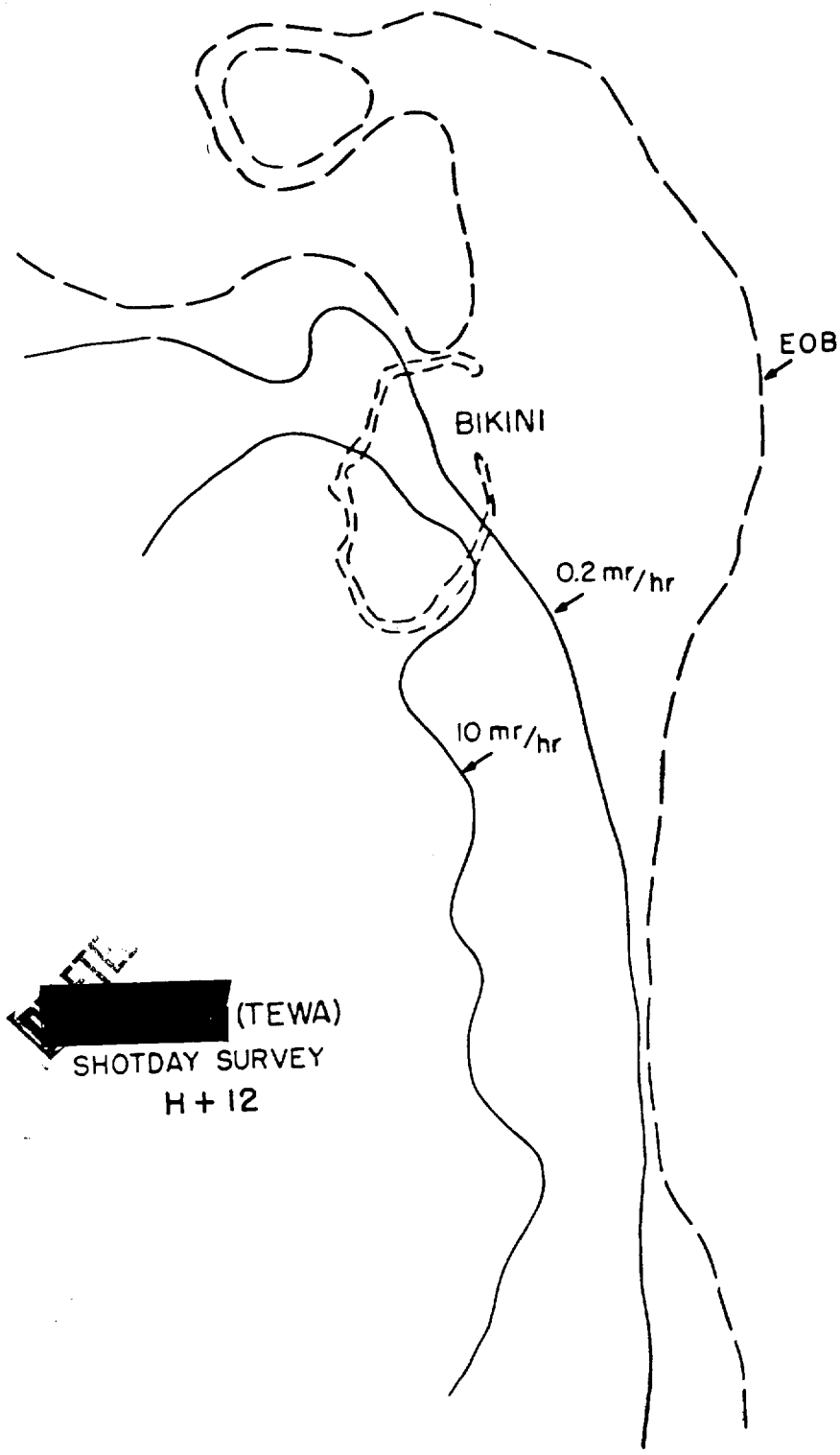

Fig. 2.64-2 - Fallout Contour Map

[redacted]

22

T

[redacted]

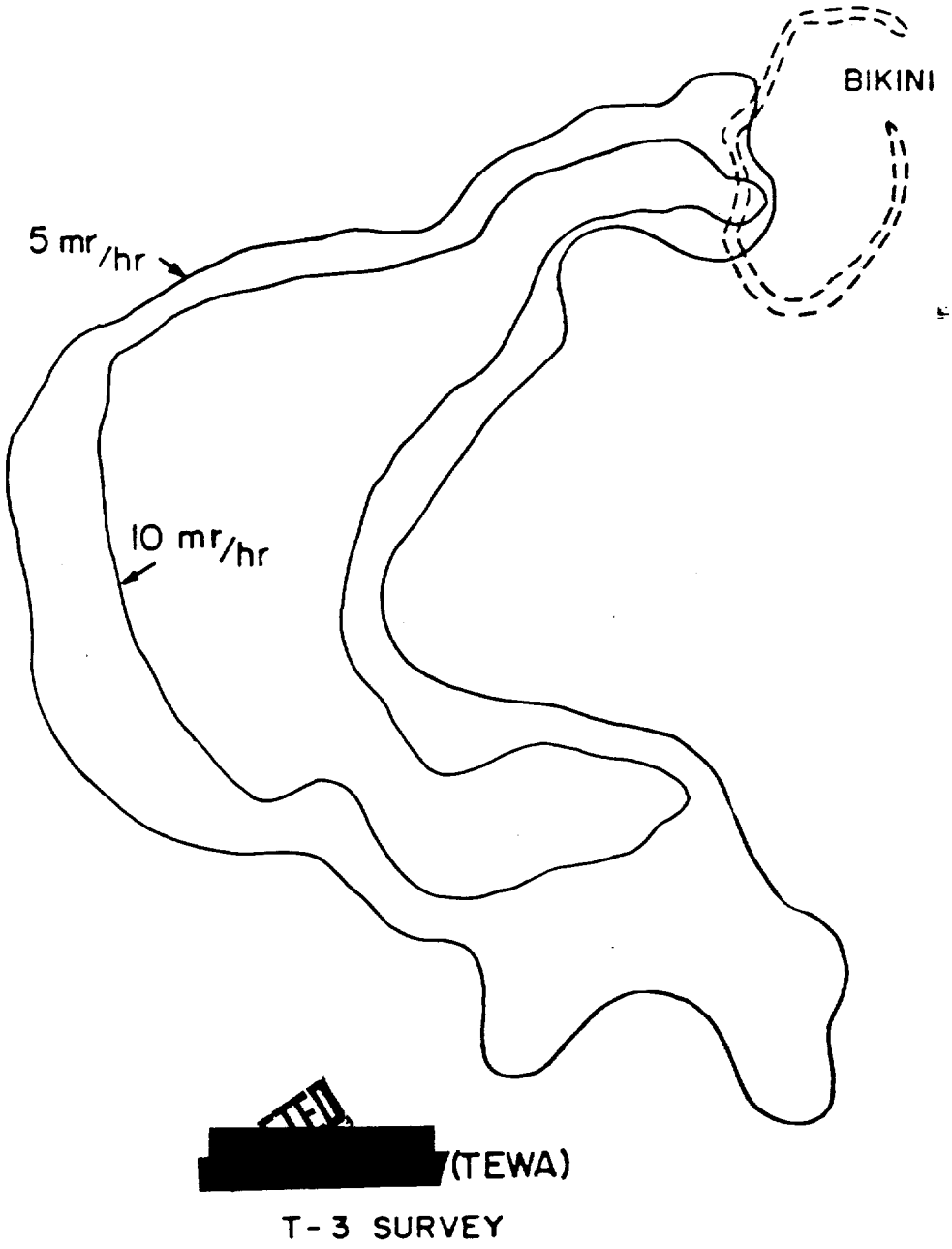

Fig. 2.64-3 - Fallout Contour Map

23

[redacted]

[redacted] (TEWA)

Project 2.65 - Analysis of Fallout and of Base Surge - M. Morgenthau

OBJECTIVES

To obtain fallout samples on land and to perform radiophysical and radiochemical measurements on the samples.

To prepare dose rate contours of the atoll area from information gathered by this project, other projects, and RadSafe.

To evaluate the role of the base surge in transport of radioactive material

DESCRIPTION AND EXPERIMENTAL PROCEDURES

Intermittent fallout collectors, (IFC), and gross fallout collectors, (GFC), were installed on islands in the Bikini Atoll and on the YAG's and LST in the expected fallout zone. The IFC timing intervals were one minute, five minutes, or 30 minutes depending on location of the collector. The equipment was installed prior to the shot and was activated by EGG Blue Boxes. Samples to be used for early decay measurements were recovered on D-day and the balance of the samples were recovered on D+1 and D+2. All of the recovery was made by helicopter. Wire signals were used to activate the base surge detectors as a warm-up period was required before shot time. Some of the stations also incorporated a tape fallout monitor, (TFM).

On D-day, D+1, and D+2, an aerial survey of residual radiation was made over the respective islands by helicopter. The measurements were taken by means of a probe on a long cable suspended below the hovering helicopter. The positions of the probe were determined by comparison with maps and aerial photographs. Two project personnel were stationed in the Program 2 Control Center to consolidate data from the various projects and to assist the Program Director in maintaining a situation plot.

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STATION LOCATIONS

The instrumentation at the various stations is displayed in Fig. 2.65-1.

RESULTS

The contamination resulting from this shot covered islands from Bikini to Airukiiji. Aerial survey by means of a probe suspended from a helicopter was conducted on D-day, D+1 and D+2. The readings obtained are shown in Table 2.65-1. These values were corrected to the H+1 hour dose rates by using a decay exponent of -1.08 obtained from field gamma decay data.

Fallout samples were recovered on D+1 and D+2 days from all the stations on the islands with the exception of Namu and Bokobyaadaa which were contaminated to such high levels as to make recovery inadvisable. The samples were processed and shipped to Army Chemical Center for analysis.

[redacted]

[redacted] (TEWA)

TABLE 2.65-1

CORRECTED AERIAL SURVEY READINGS
(Field Gamma Decay Factor; -1.08)

Island	Day	Time after shot (hrs)	Corrected reading (mr/hr)	r/hr at H+1 hr	Avg H+1 reading (r/hr)
Eniirikku	T	8.98	4000	43	
	T+1	32.5	1000	43	42
	T+2	57.1	500	39	
Chieerete	T	9.17	19000	210	
	T+1	32.4	6500	280	230
	T+2	57.0	2500	195	
Ourukaen	T	9.28	38000	420	
	T+1	32.3	9200	395	425
	T+2	56.8	5900	465	
Bokororyuru	T	9.33	19000	210	
	T+1	32.3	9200	395	320
	T+2	56.8	4600	360	
Bokobyaadaa	T+1	32.1	37000	1570	1455
	T+2	56.6	17000	1335	
Namu	T+1	32.0	37000	1570	1485
	T+2	56.5	18000	1400	
Yurochi	T+1	31.5	16000	670	630
	T+2	56.4	7500	585	
Uorikku	T+1	31.8	15000	630	580
	T+2	56.3	6800	530	
Romurikku	T+1	31.8	13000	545	470
	T+2	56.1	5000	390	
Aomoen	T+1	31.7	7400	310	325
	T+2	56.1	4300	335	

IFC - Intermittent-Fallout-Collector
GFC - Gross-Fallout-Collector
TFM - Tape Fallout Monitor
BSD - Base Surge Detector

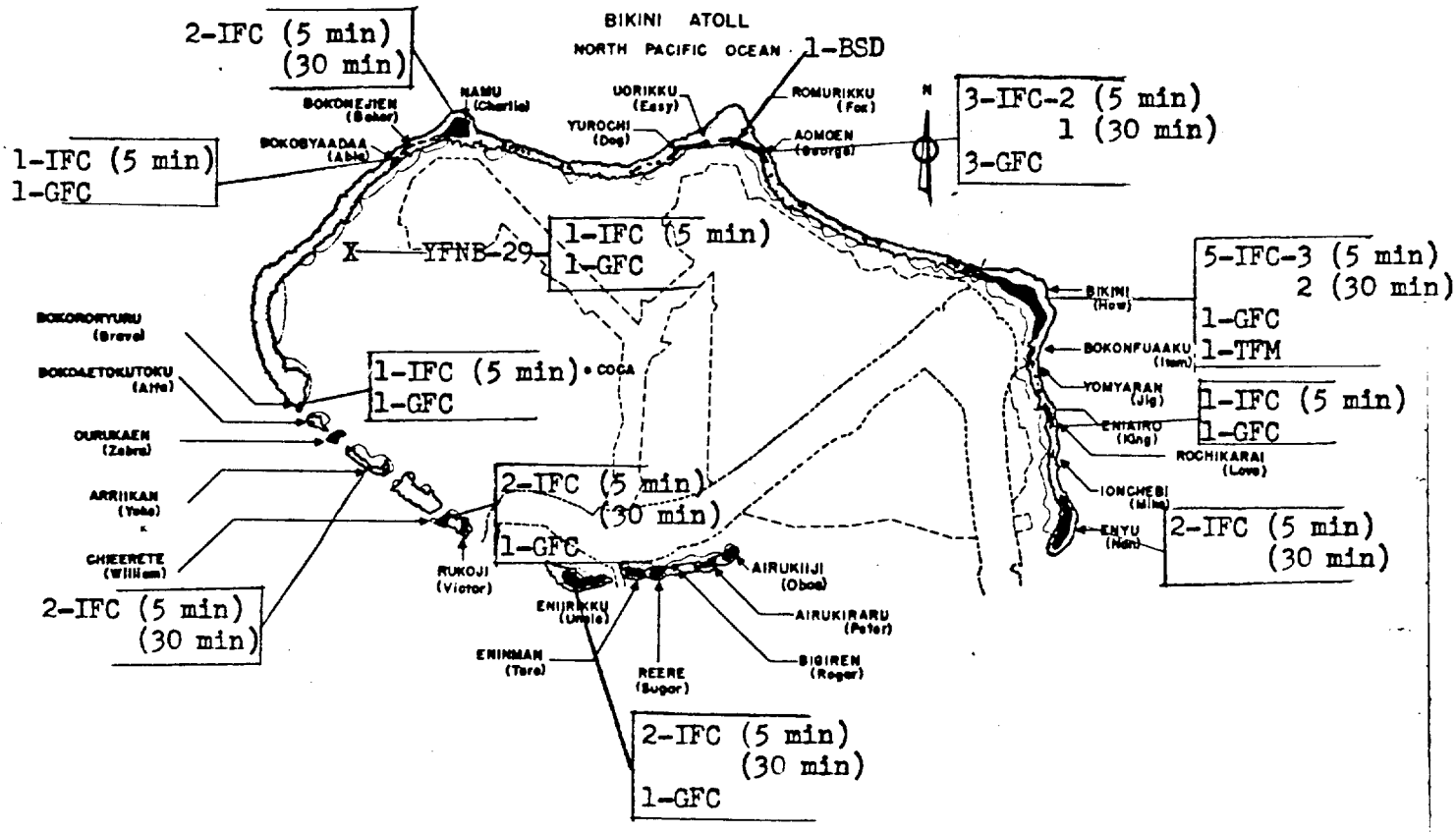

Fig. 2.65-1 - Instrumentation

[redacted] (TEWA)

Project 2.71 - Relative Importance of the Various Radiation Sources to the Ship Shielding Problem - H. R. Rinnert

OBJECTIVES

To determine the relative radiation dose rates contributed by contamination of the air envelope, water envelope, and the ship's weather surfaces.

To determine the time dependent gamma ray combined absorption and scattering coefficients of still to be used in future calculations of shielding effectiveness.

To field test new and improved detector systems.

To obtain gamma radiation measurements at various points on and in the ship as a function of time for the following purposes:

Check points for future shielding calculations

Determination of the radiological situation at various locations aboard ship for Projects 2.63 and 2.10, to be used for operational control of the test ships.

GENERAL

Both YAGs received levels of contamination adequate for the satisfaction of project objectives.

Preliminary indications are that the rains encountered by the YAGs on D + 1 will not prejudice the satisfaction of objectives.

The instrumentation performed satisfactorily.

RESULTS

Relative Gamma Radiation Fields Contributed by Various Radiation Sources

Fig. 2.71-1 and 2.71-2 show the percent air contribution to the gamma radiation field on the deck of YAG 39. As in previous events, the

[redacted]

air contribution during fallout was very significant. In the washed area, at time of maximum fallout the air contributed close to 100% of the gamma dose rate and about 84% of the gamma dose observed on deck, and at the time of cessation of fallout the air had contributed about 42% of the gamma dose observed on deck.

Fig. 2.71-4 through 2.71-7 show the gamma doses and dose rates observed on the decks of the two YAGs.

Fig. 2.71-8 shows the estimated gamma dose and dose rate contributed by the air to the deck of YAG 39.

Fig. 2.71-9 and 2.71-10 show the gamma dose rates at several interior locations in YAG 39. The variations in the dose rates in the fireroom and recorder room may be due to contaminated sea water; however, lack of time has prevented examination of water contributions at this time.

Interaction of Gamma Radiation with Steel

Gamma radiation fields inside steel cylinders of various thicknesses were compared as a function of cylinder thickness and time. Least square lines were calculated and drawn for plots on semi-log paper. (See Fig. 2.71-11 and 2.71-12).

Combined absorption and multiple scattering coefficients for steel were calculated. These coefficients are presented and compared with results from other shots in Fig. 2.71-3. The [redacted] (Tewa) results appear to be duplicating the [redacted] (Flathead) results. Whether the rain caused fractionation and thus accounts for the sudden flattening of the [redacted] (Tewa) curve remains to be determined.

CONCLUSION

Participation in this shot supplied data believed to be adequate for the satisfaction of all project objectives.

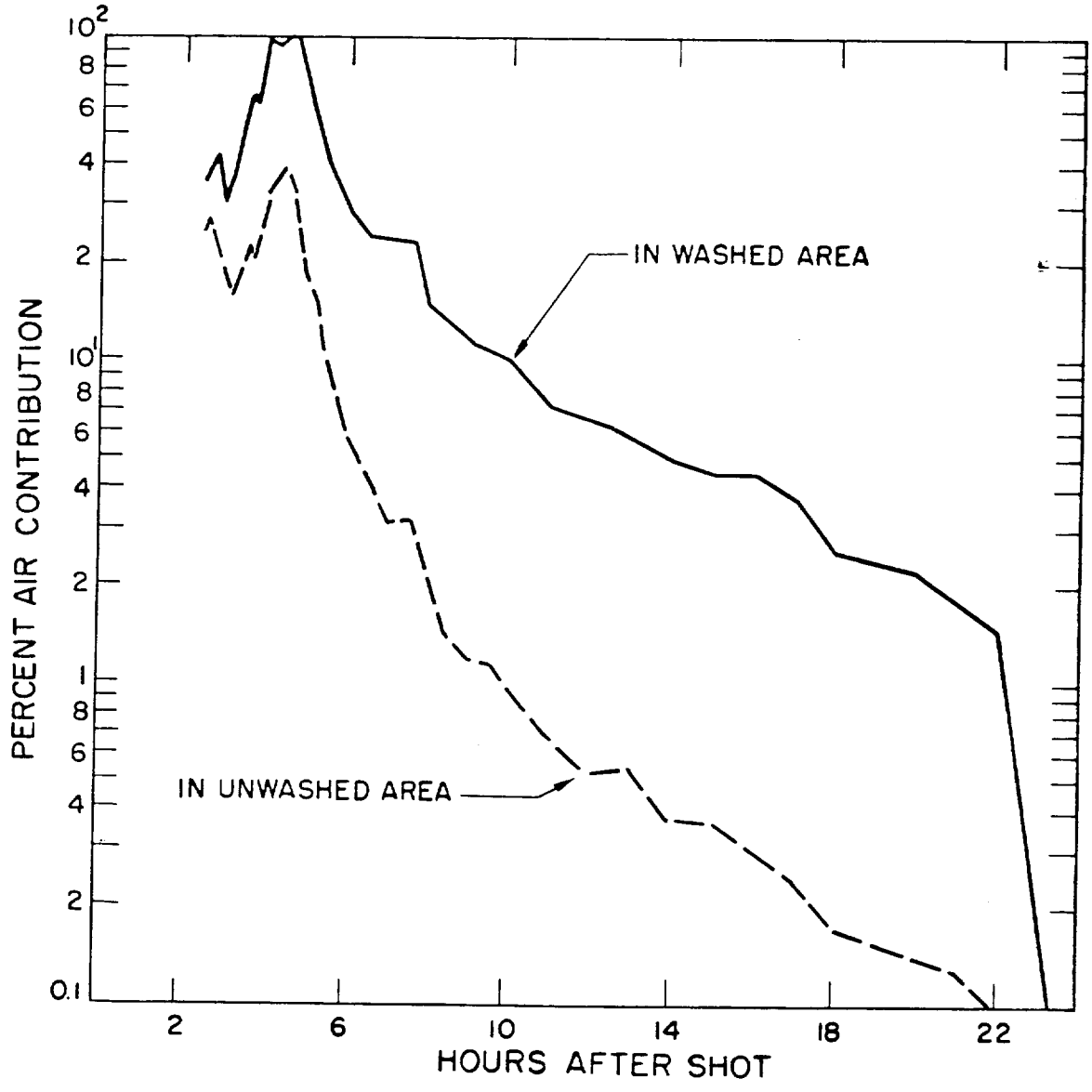

Fig. 2.71-1 - Percent Air Contribution to Gamma Dose Rate on Deck of YAG 39, [redacted] (Tewa)

30

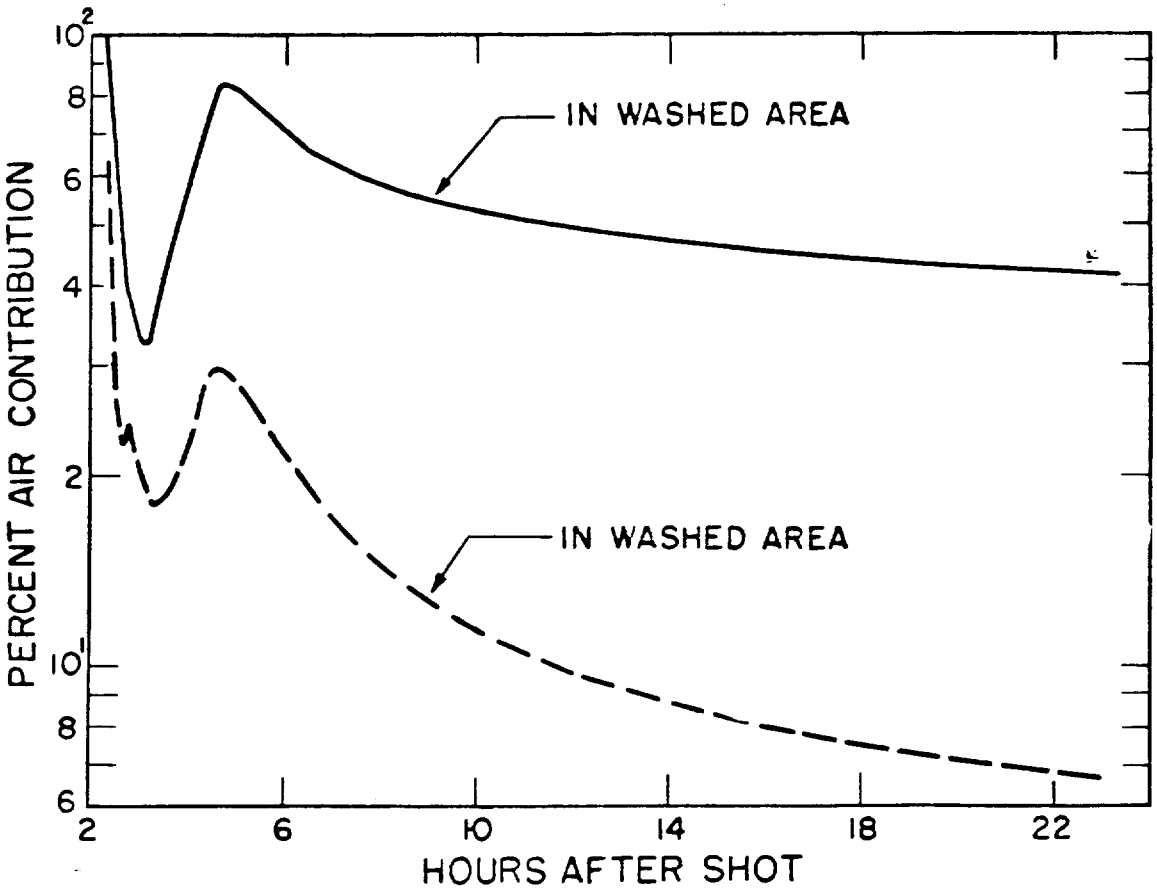

Fig. 2.71-2 - Percent Air Contribution to Gamma Dose on Deck of YAG 39, (Tewa)

31

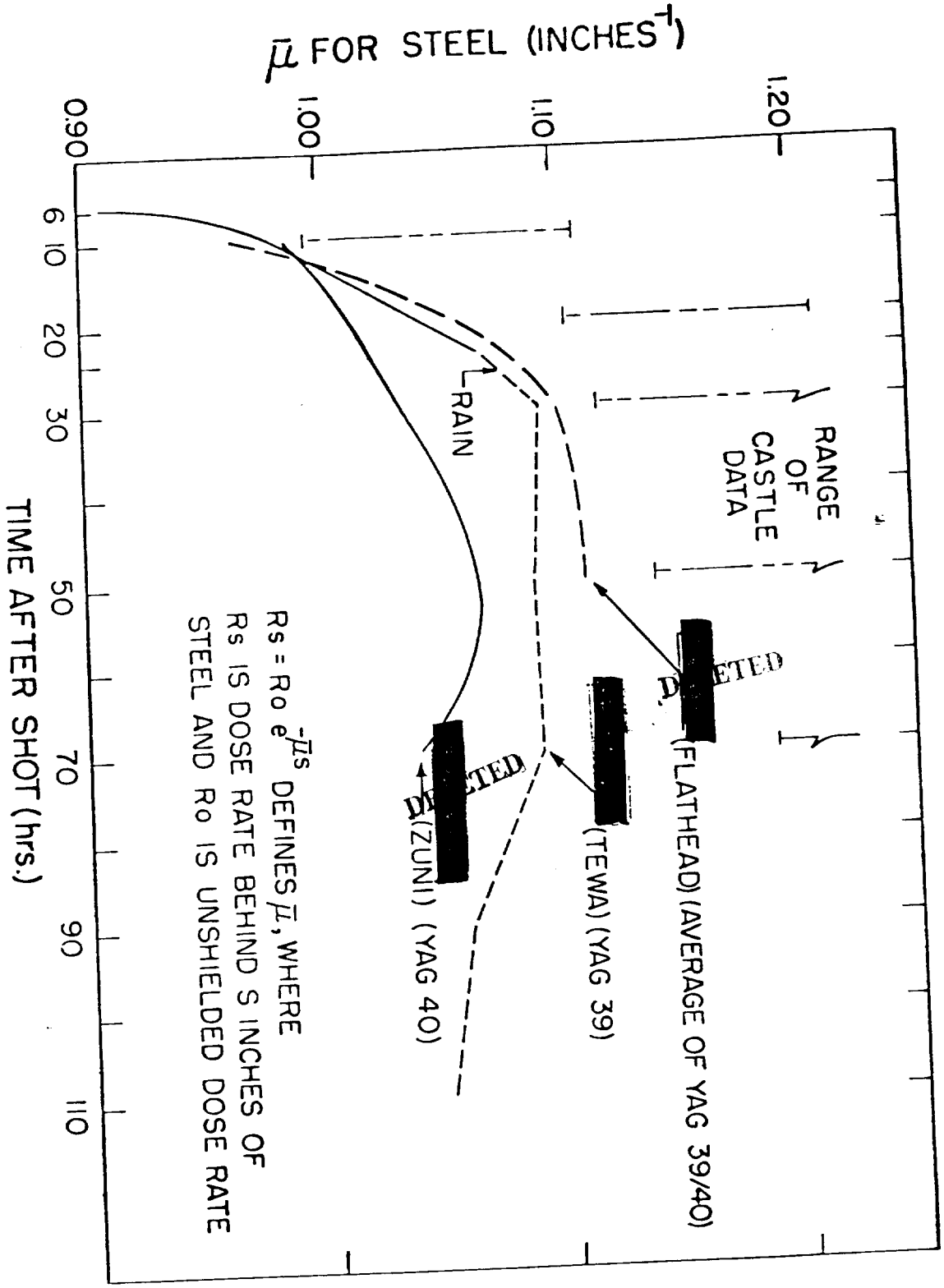

Fig. 2.71-3 - Combined Gamma Absorption & Scattering Coefficient for Steel, $\bar{\mu}$, as a Function of Time, [redacted] (Tewa)

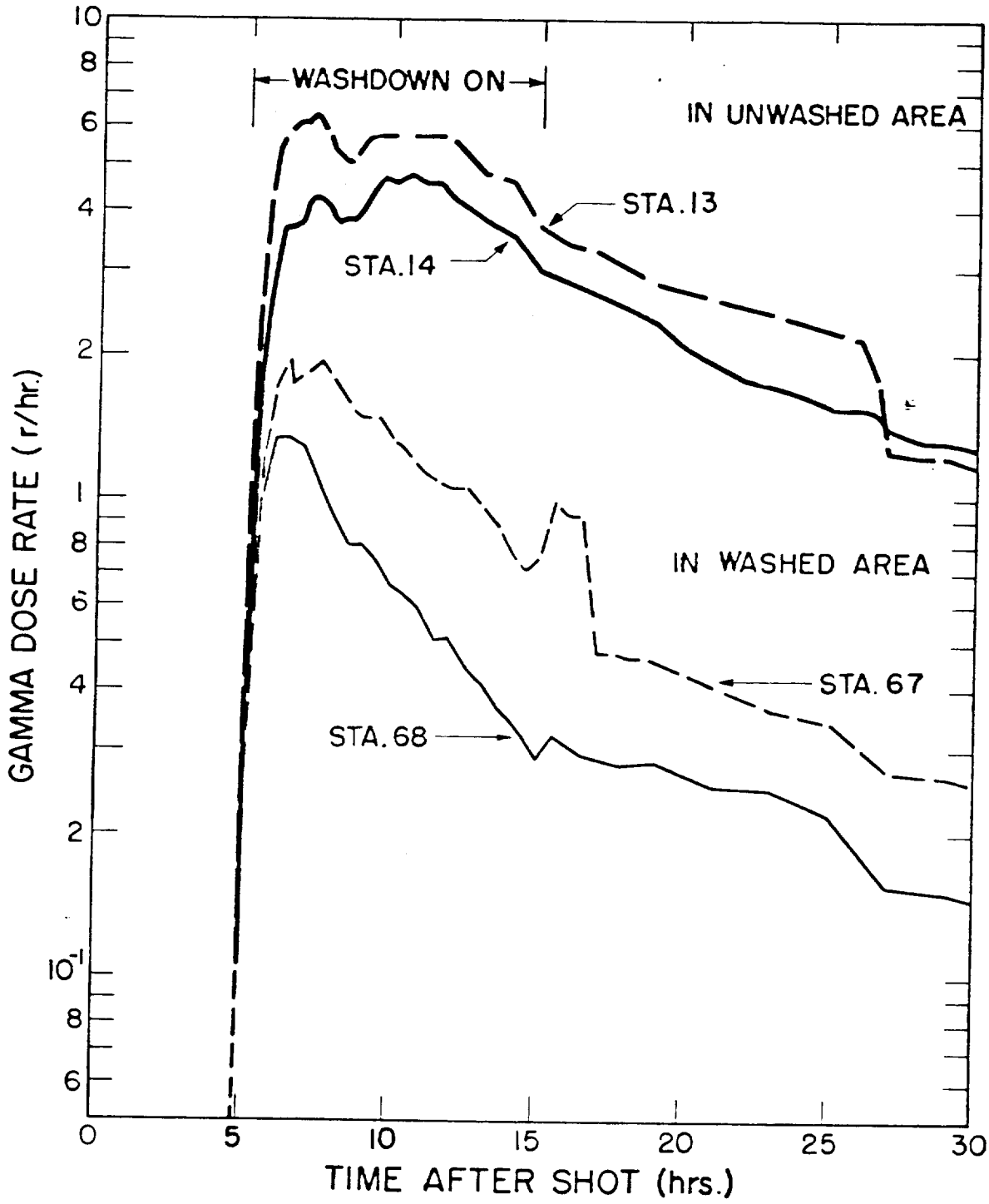

Fig. 2.71-4 - Gamma Dose Rates on Deck of YAG 40 for [redacted] (Tewa)

33

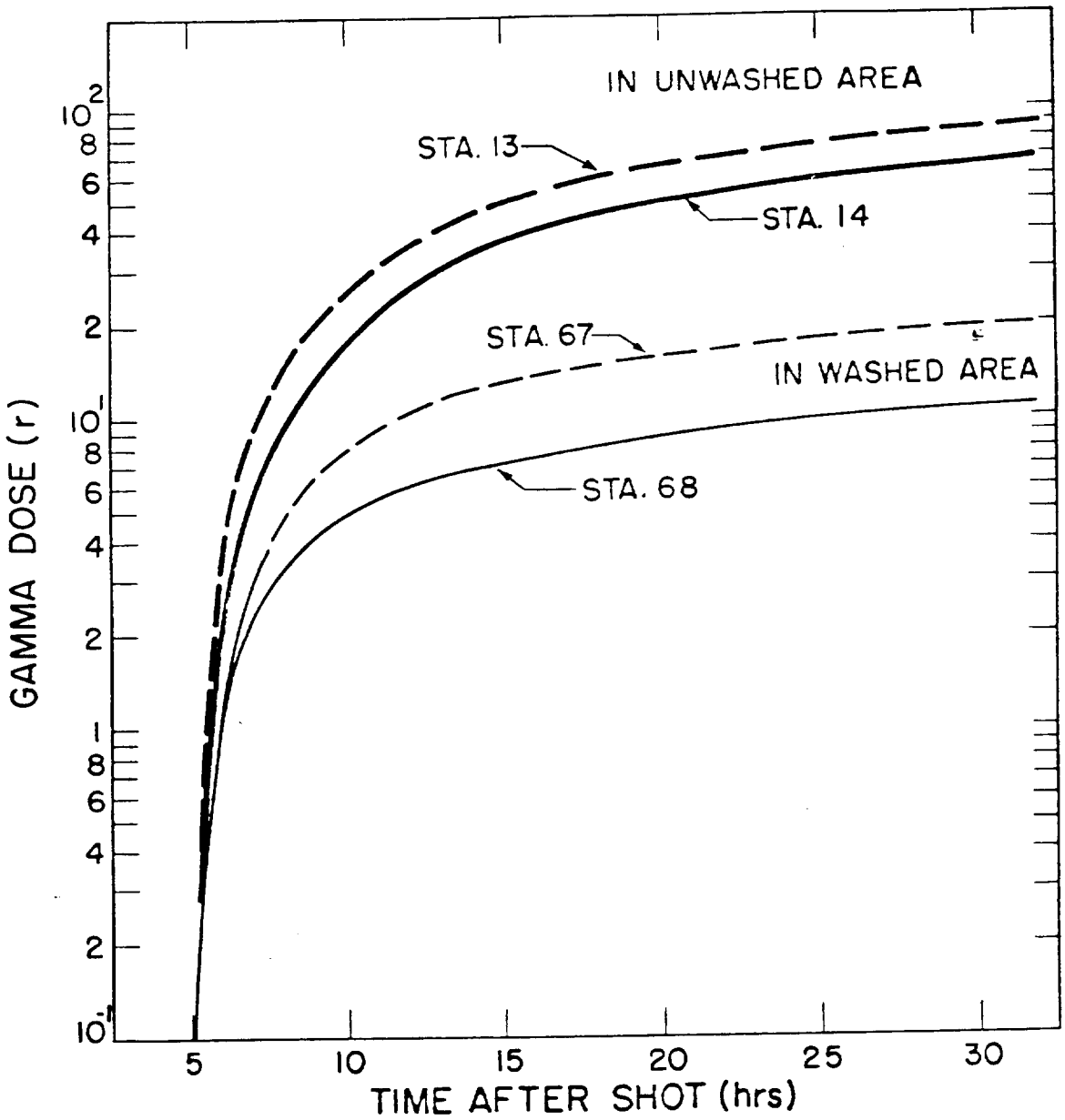

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Fig. 2.71-5 - Gamma Dose on Deck of YAG 40 for [redacted] (Tewa)

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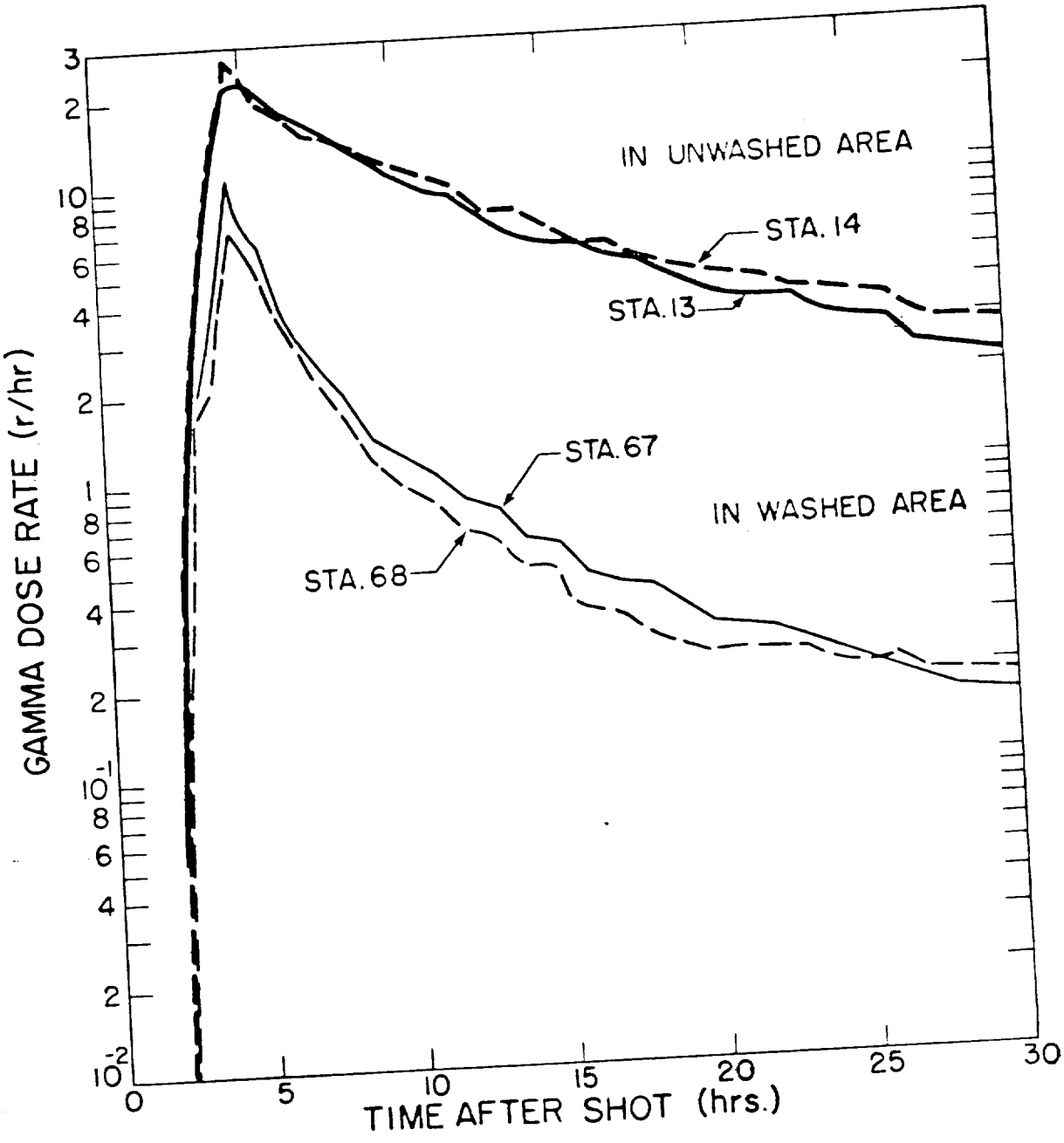

Fig. 2.71-6 - Gamma Dose Rates on Deck of YAG 39 for [redacted] (Tewa)

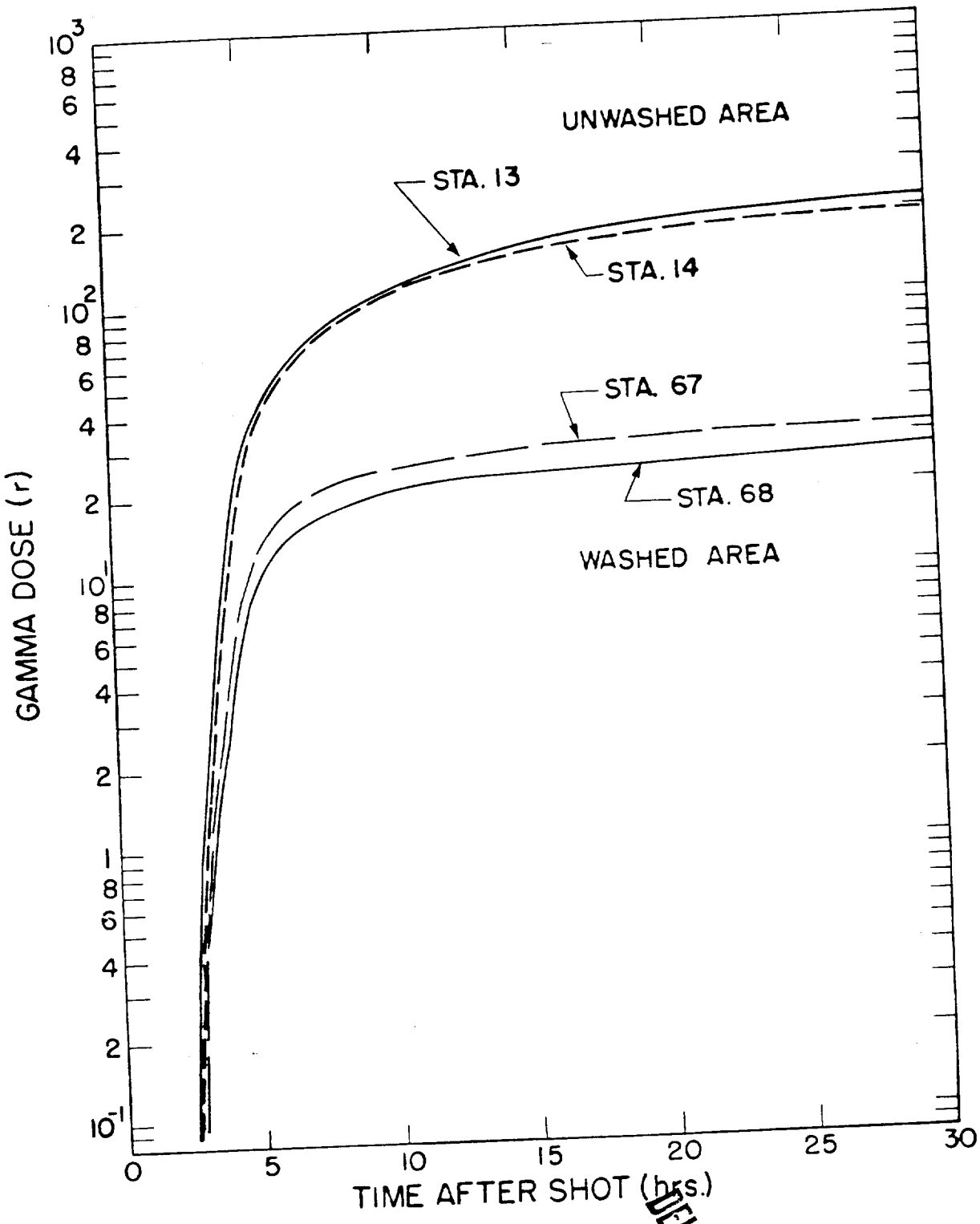

Fig. 2.71-7 - Gamma Doses on Deck of YAG 39 for [redacted] (Tewa)

[redacted]

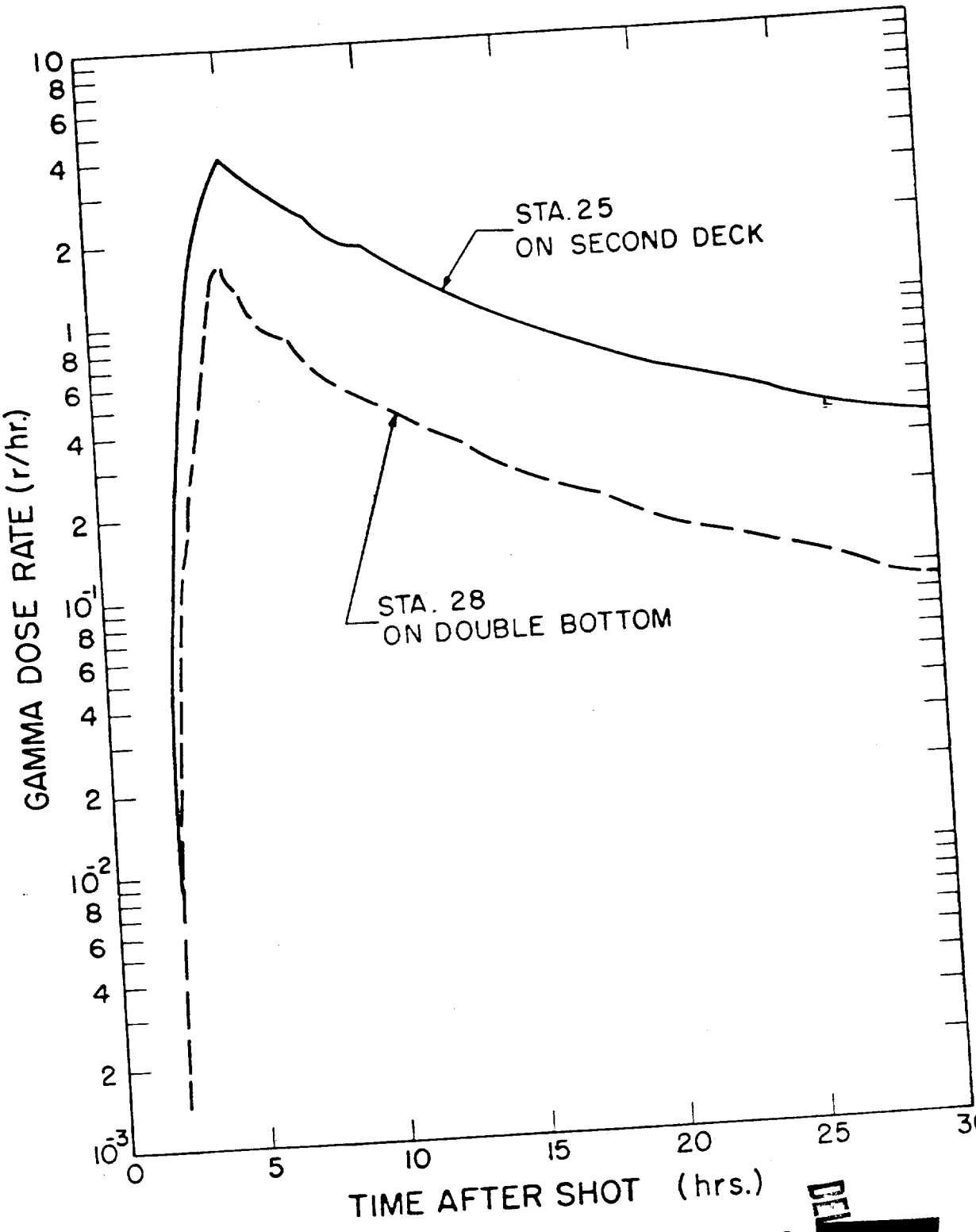

Fig. 2.71-9 - Gamma Dose Rates in No. 2 Hold of YAG 29 for [redacted]
(Tewa)

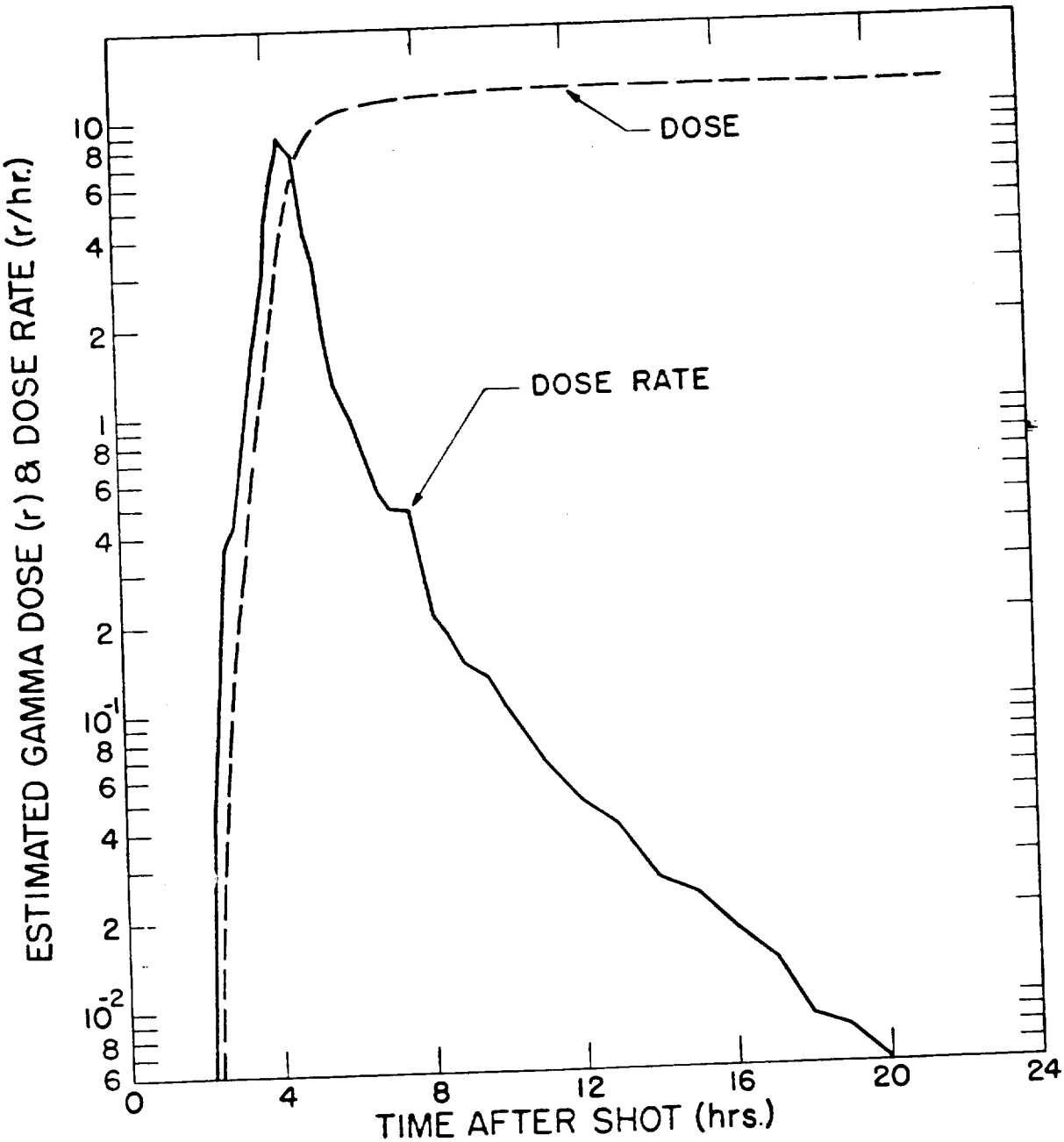

Fig. 2.71-8 - Estimated Air Contribution to the Gamma Radiation Field on Deck of YAG 39, [redacted] (Tewa)

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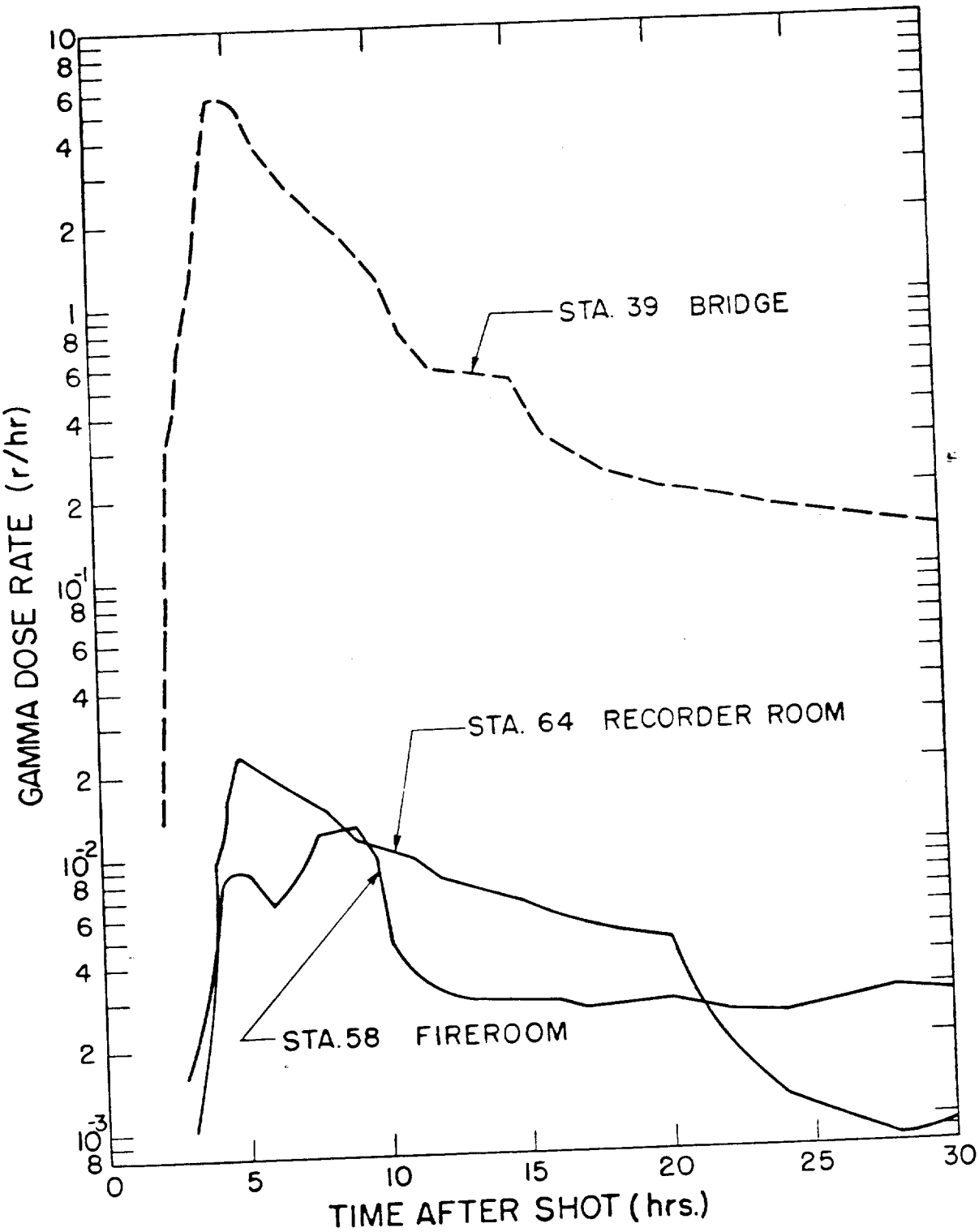

Fig. 2.71-10 - Gamma Dose Rates in Other Interior Locations on YAG 39 for [redacted] (Tewa)

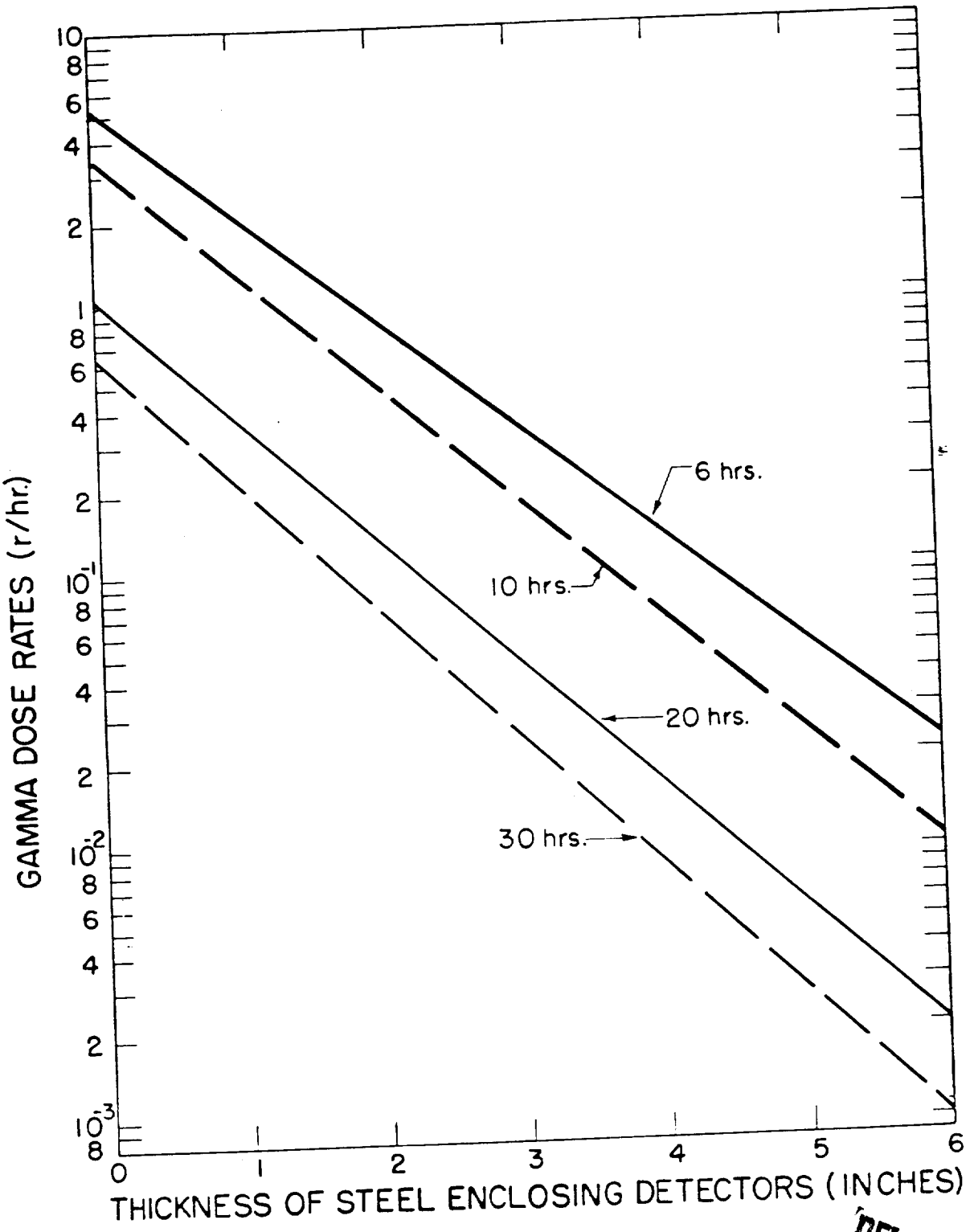

Fig. 2.71-11 - Gamma Dose Rates Inside Steel Cylinders of Var[redacted] Thicknesses on YAG 39 for Several Times After [redacted] (Te

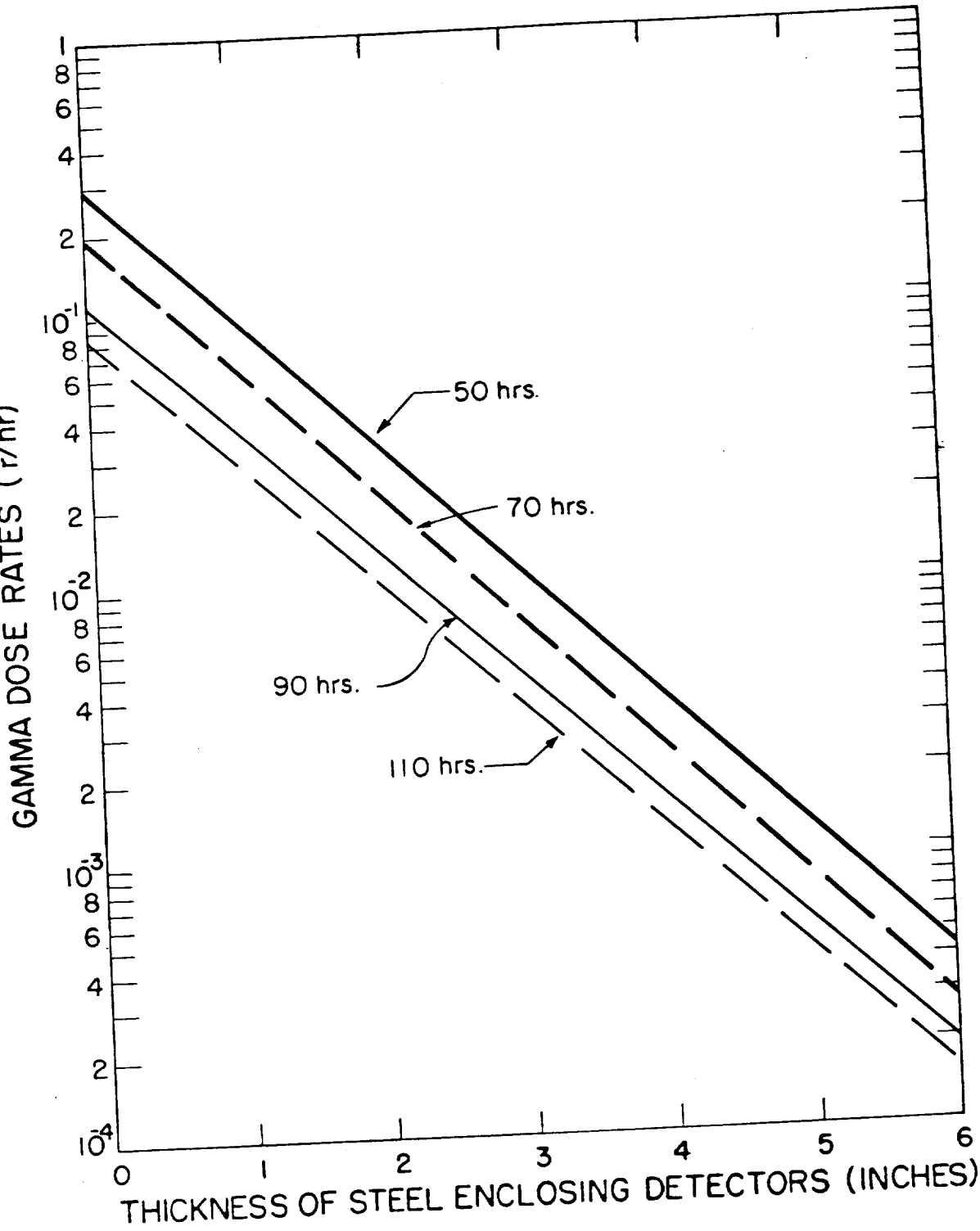

Fig. 2.71-12 - Gamma Dose Rates Inside Steel Cylinders of Various Thicknesses on YAG 39 for Several Times After [redacted] (Tewa)

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[redacted] (TEWA)

Project 2.72 - Evaluation of Standard Navy Dosimeters in Residual Radiation Fields Aboard Ship - S. C. Rainey

OBJECTIVE

To determine whether or not the standard dosimeters DT-60/PD and IM-107/PD read the biologically significant 3-5cm depth dose when worn aboard ships by personnel under atomic warfare conditions.

PROCEDURE

Nine man-sized masonite (unit density) phantoms were used. These were mounted on the YAG-39 and YAG-40, seven above decks and two below decks. On the chest of each phantom, 10 DT-60/PD's, 6 IM-107/PD's, 2 IM-93/UD's, and 2 NBS film badges were mounted. A similar array was mounted on the backs of the phantoms. Depth dose configurations in each phantom were determined by the use of small phosphate glass needles at a number of depths through the phantom.

These loaded phantoms accompanied the YAG's on their sorties for [redacted] (Tewa). Upon return of the ships to Eniwetok, the dosimeters and needles were removed, and the radiation doses were read.

RESULTS

Depth dose configurations were obtained from four phantoms. Comparisons showed that the DT-60/PD readings on the surface of the phantom read about 50% higher than the 3cm depth dose. The quartz fiber dosimeters (IM-107/PD and LM-93/UD) averaged nearly a factor of two higher than the three centimeter depth dose. The film badges averaged about 20% higher. Position variations in readings of the

dosimeters on the front or back of the same phantom were considerable. Below deck, however, readings were quite consistent.

CONCLUSIONS

If the reading of a single DT-60/PD or IM-107/PD, such as might be worn by a man on the weather deck of a ship, were used as the basis for a medical, tactical, or administrative decision, a considerable error might result. Below decks, results would be more reliable.

[redacted] (TEWA)

Project 2.8 - Shipboard Countermeasures Methods Studies - R. H. Heiskell

W. S. Kehrer

OBJECTIVE

To determine the relative effectiveness of various proposed ship and personnel protection and reclamation methods.

DESCRIPTION AND EXPERIMENTAL PROCEDURES

The shipboard countermeasures methods studies were divided into eight problems to be carried out on the YAG-39 and YAG-40 and at the RadSafe Center on Parry Island. These involved the study of the effectiveness of various shipboard protective methods, decontamination methods, hazard assessment methods, personnel protection and decontamination methods, and basic contaminability-decontaminability studies. Monitoring service was provided for Projects 2.7, 2.9 and 2.10.

Experimental problems follow:

Protection of Miscellaneous Shipboard Materials: Canvas samples were placed on board the YFNB-13 and the YAG-40. Various sizes of manila line and wire rope were also placed on board the YAG-40. The canvas sample materials were removed on T+2 days. The manila line and wire rope were disposed of because they were not "hot" enough to return to NRDL.

Methods of Reducing Radiation from Contaminated Wood Decks: Samples of various woods were placed in racks on the flight deck and after deck house of the YAG-40 and decontaminated by Project 2.9 during their decontamination of the ship.

[redacted]

Skin Decon and Protection Methods: The hands of the ship's crews aboard the YAG-39 and YAG-40 when they returned to Parry Island, the decontamination crews, and technical personnel who went aboard the ships before and during the decontamination period were monitored when they arrived at the decon tent. "Hot" hands were divided into two groups to be decontaminated with waterless cleaner or with soap and water. No barrier cream was used.

Monitoring and Hazard Assessment Methods: Gamma surveys at 3 feet and 1 inch, beta surveys with the instrument in contact with the surface were made, and wipe samples were taken at specified points before and after decontamination of the YAG-39 and YAG-40.

Basic Contamination Studies: No results were obtained because the sample plates were missing from the YFNB-13 at the time of sample recovery.

RESULTS AND CONCLUSIONS

The canvas samples were recovered and sent to NRDL for further experimental tests.

Some of the wood deck samples were monitored for beta activity and an area on the flight deck was monitored for beta and gamma activity before and after decontamination. The data is being processed.

The data obtained from monitoring the ships is being processed.

Preliminary results indicate that the waterless cleaner, and soap and water have about the same effectiveness in removing contaminant from the hands.

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[redacted] (TEWA)

Project 2.9 - Standard Recovery Procedure for the Tactical Decontamination of Ships - F. S. Vine

PROCEDURE

LST-611 was decontaminated on T+2 by the ship's force. The firehosing-handscrubbing procedure was used.

YAG-40 was decontaminated on T+2 and T+3. Manpower was supplied by the ship's force. Two-man hot liquid jet lances (2) driven by a 6000 gal/hr Sellers Injector were used on the superstructure and the non-washdown area forward. The remainder of the ship aft was decontaminated by firehosing and handscrubbing with detergent.

YAG-39 was decontaminated on T+3 and T+5. The interruption was occasioned by technical requirements of Project 2.71 which prohibited decontamination of the non-washdown area prior to T+5. Firehosing and handscrubbing were used throughout.

RESULTS

The contaminant was particulate and similar to that resulting from the [redacted] (Zuni). It was not tenacious. Shipboard radiation levels on arrival at Eniwetok were appreciably higher than those encountered after previous shot participations. However, significant contamination was found only on the YAGs 39 and 40. Average initial levels aboard both ships were approximately 500 mr/hr in the non-washdown areas and 75-100 mr/hr in the washdown areas. Decontamination reduced these levels by a factor of ten.

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[redacted]

CONCLUSIONS

The decontamination effectivenesses obtained and the degree of effort required for their attainment were peculiar to the particular contaminant and cannot be considered typical of the conditions which would be encountered by Navy ships during and after an attack with nuclear weapons in the open sea.

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[redacted] (TEWA)

Project 2.10 - Verification of Washdown Effectiveness as a Shipboard Radiological Countermeasure - M. M. Bigger

OBJECTIVES

Operation of YAGs and LST to be stationed in fallout area.

RadSafe for NRDL Projects.

Washdown effectiveness evaluation.

PROCEDURE AND RESULTS - SHIP OPERATIONS

The project ships, YAG-39, YAG-40 and LST-611 successfully completed their mission on the [redacted] (Tewa) shot. A preliminary plot of the YAG-39 and YAG-40 tracks is shown in Fig 2.10-1. More complete information regarding all phases of ship and instrument operations has been given to Project 2.63 for inclusion in their reports.

YAG-39 OPERATIONS

Fallout arrived on the YAG-39 at 12°05'N, 165°11'E, approximately 25 miles north of the shot point. The ship was headed into the wind and proceeded at 2 knots for a distance of 6 miles. At 1030, the ship began to steer a figure eight course with the center at 12°01.5'N and 165°18'E and held the center of the figure eight within a mile of this station. The figure eight was about 2 miles long and the wind was always on or forward of the beam.

At 1648, a drogue was launched and the ship kept station on this drogue, steering a figure eight, until relieved by the M/V Horizon at 0245 on T+1 (22 July 1956). The ship headed for Bikini to off-load samples. This was accomplished between 0745 and 0800 and the ship was back in company with the Horizon at 1300. From 1300 to 1515, water samples were taken on each ship and similar water measurements (profiles) taken for comparison. Difficulty

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in raising the SIO probe aboard the YAG-39 prolonged this event. The Horizon departed and the YAG-39 continued to keep station on the drogue. After considerable difficulty in lowering and raising the SIO probe, a technique of stopping the ship during this measurement was adopted but by 1800 the gear was no longer operable and after taking a final set of water samples this ship departed for Eniwetok at 2054.

Throughout the time from the beginning of fallout to the return to Eniwetok, the ship was closed and personnel remained in shielded spaces except as necessary to accomplish ship and project work. Due to the numerous events, the radiological situation and washdown operation are best presented in a chronological table.

0747	Fallout arrival
0753	Washdown on
0828	Washdown off. Men to TV camera at mast head and to release jammed limit switch on SIO probe hoist.
0853	Washdown on
1100	Peak activity on fore deck of 27 r/hr
1245	Estimated time of cessation of principal fallout. The Captain observed from the bridge that washdown nozzles on the top of house (flying bridge) were probably closed.
1530	Turned washdown off. Took air sample--well above tolerance--noted much loose material on deck. Valves controlling nozzles on top of house opened.
1550	Washdown on
1635	Washdown off. Drogue launched and took water samples.
1703	Washdown on
1941	Washdown off. Took air sample--searched for and found drogue.
2050	Washdown on
2125	Washdown off to sight drogue
2135	Washdown on
2158	Washdown off--took water samples.
2240	Washdown on
2325	Washdown off to sight drogue.
2345	Washdown on

T+1 (22 July 1956)

0020	Washdown off to sight drogue
0026	Washdown on
0210	Washdown off. Took water samples, opened engineroom vents and hatch.
Notes:	At meal time only, starting with breakfast, the two aft passage way doors on the main deck were opened to provide ventilation and reduce the high ambient temperatures in the galley. After opening the engineroom ventilation, shoe covers and gloves were required in the engine room. The engineroom door was kept closed.

T+2 (23 July 1956)

While returning to Eniwetok, a survey was made at 0800, T+2, with results as follows:

Forecastle -- 300 mr/hr (washed area)
Flight deck -- 400-600 mr/hr
#2 hatch -- 1.0 to 1.4 r/hr with higher hot spots
Boat deck -- 150-300 mr/hr
Flying bridge -- 300 mr/hr
#4 hatch -- 150-200 mr/hr
#5 hatch -- 100 mr/hr
Engineroom -- 6 mr/hr

1300 Anchored Eniwetok. Crew from shore came aboard to drop anchor. Personnel debarked thru cargo hatch in side of ship. This provided a clean entrance and exit to the interior of the ship.

At present writing, ship decontamination is nearly completed, however, it is apparent that an operational clearance with some restrictions will be necessary for the homeward voyage.

Note: Some of the contamination on deck was visible, and appeared as a fine sand accumulating in cracks, around structures and near scuppers.

YAG-40 Operations

Fallout arrived at the YAG-40 at 12°05'N, 164°45'E, approximately 40 miles northwest of the shot point. The time was 1010, 21 July 1956. The ship headed into the wind at 2 or 3 knots for a distance of 6 miles and then performed a figure eight to hold station with the wind on or forward of the beam. This was done at 1400, Lat. 12°04.7'N and Long. 164°53'E.

The washdown of the aft part of the ship was activated at 1048. Peak radiation levels of 7 r/hr on the fore deck occurred at 1245, 6 r/hr from 1600 to 1800 and 5 r/hr from 1900 to 2000.

The washdown was secured at 2056. The ship's force proceeded to decontaminate the bridge area, boat deck and main deck aft.

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At 0012, 22 July 1956 (T+1), the ship proceeded to Bikini to off-load samples. This was completed and at 0800 the ship departed for Eniwetok arriving there at 0700, 23 July 1956 (T+3). Decontamination was started immediately.

The fallout on the YAG-40 was described as consisting of 3 types of particles namely, dry spherical solids, irregular solids and branched agglomerates.

LST-611 Operations

The LST-611 first received fallout at 1300 on T-day at 12°25.8'N, 164°39.0'E, approximately 60 miles northwest of surface zero. At the beginning of fallout, the ship headed into the surface wind and proceeded slowly until a distance of 6 miles had been traversed, when the figure eight maneuver was employed.

Fallout ceased at about 2000 on T-day with a maximum reading in the platform of 250 mr/hr, while the maximum deck reading was 650 mr/hr at 1830 on T-day.

The ship departed station for Eniwetok at 0210 on T+1, arriving at Parry Island at 1800 the same day.

The ship was closed and the washdown system activated at 1312 T-day and the system was secured and the ship opened at 0615 on T+1, after washdown was secured, personnel movements on the weather decks were restricted due to the removable contaminant present and the interior of the ship was kept clean.

Upon arrival at Eniwetok, the weather decks were reading 50-95 mr/hr open window and 15-30 mr/hr closed window with a Cutie Pie. One scupper on the main deck was reading 7 r.

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The ship's operational gear functioned properly except for the Hercules fire and flushing pump which ran out of fuel at 1640 on T-day due to a fuel leak. At 1845 the pump was put back on the line and it failed again at 0345 for the same reason. While this pump was inoperative, the volume and pressure of the washdown water was reduced considerably.

The cyclic air sampler showed no internal airborne activity at any time. Externally, there was no airborne hazard detected after 0300 on T+1.

RADSAFE SUPPORT

Ship Support

The number of RadSafe personnel on board the LST-611 and the YAG's 39 and 40 were the same as for previous events.

The YAG-39 received the heaviest fallout of the three ships involved. Excellent RadSafe cooperation on the part of the ship's personnel kept the spread of contamination to the ship's interior to a minimum. The maximum personnel dosage received was 1.75 r. The average exposure was approximately 700 mr. Ten cases of skin contamination occurred with a maximum detected of 40 mrep/hr including 2 mr/hr. In all cases the contamination was successfully reduced to an acceptable level by soap and water scrubbings. The maximum air contamination measured inside the ship was $1 \times 10^{-7} \mu c/cc$. Fallout was detected at 0745 with a peak radiation level of 41 r/hr occurring at 1100 on T-day. Fallout was complete at 1200 on T-day. By T+6, the YAG-39 had been decontaminated to a level that would permit return to the ZI with an estimated average crew radiation dosage of 1.5 r and would permit access to the aft portion of the ship without protective clothing.

Fallout on the YAG-40 started at 1015 on T-day and reached a maximum of 7.5 r/hr at the forward starboard TIR at 1200. Thirteen cases of skin contamination occurred with a maximum of approximately 20 mr/hr. All were

successfully decontaminated to acceptable levels with soap and water. By T + 5 day the YAG-40 had been decontaminated to levels that would permit return to the ZI with an estimated average crew dosage of 1 r and would permit access to the weather decks on the superstructure and aft of the superstructure with no protective clothing.

Fallout on the LST-611 started at 1250 on T-day and reached a maximum of 650 mr/hr as measured by a deck TIR at 1830. Thirty-three cases of skin contamination occurred with a maximum of 20 mrep/hr measured at a distance of 1½ feet. All were successfully decontaminated to acceptable levels with soap and water. By T + 2, the ship was decontaminated to levels that would permit operation of the ship at crew exposure levels of less than 300 mr per week and that would not require protective clothing in any portion of the ship.

Support at Bikini

Project 2.63 support at Bikini was similar to that supplied for previous events.

Early samples were recovered from the YFNB-13 on T-day with an average dose rate of 3 r/hr. Maximum sample reading was 1.0 r/hr at 3". Early recovery of samples from Bikini Island (North) and standard pattern monitoring was accomplished at exposure levels of 250 mr/hr maximum. Maximum sample reading was 100 mr/hr at 3".

On T + 1, samples were recovered and the standard pattern was monitored at a maximum exposure rate of 100 mr/hr. Maximum sample reading was 40 mr/hr at 3". Also on T + 1 samples were recovered from the rafts at maximum exposure rates of 50 mrep/hr including 20 mr/hr on raft #1, greater than 10 rep/hr including 8 r/hr on raft #2 and 8 rep/hr including 300 mr/hr on raft #3. A dosage of 500 mr was received during recovery of raft #2. On T + 1 skiff recovery was started. The maximum dose rate encountered was 3.8 rep/hr including 380 mr/hr while recovering skiff #7 at Station 11.

[redacted]

On T+2 skiff recovery was continued at dose rates up to 1200 mrep/hr including 80 mr/hr. YFNB-29 samples were recovered on T+2 at maximum dose rates of 1.2 r/hr. Maximum sample reading was 1.5 r/hr at 2". A sample of coral dust reading 50 r/hr at 4" was also recovered from the YFNB-29.

On T+3, the final YFNB-13 samples were recovered at a maximum dose rate of 30 mr/hr. Also on T+3 the cone samples were recovered from Aomoen and Namu at dose rates of 1.4 r/hr on Aomoen and 9 r/hr on Namu. The samples read 80 mr/hr and 150 mr/hr at 3" respectively.

On T+4, the final rollup of the YFNB-29 was accomplished at a maximum dose rate of 150 mr/hr.

WASHDOWN EFFECTIVENESS

Both YAG-39 and YAG-40 encountered fallout after this shot. Radiation intensities aboard both ships were sufficiently high for washdown evaluation to be made. However, only the YAG-40 records have been reduced to useable form. Early examination reveals that the YAG-39 data will give a satisfactory evaluation when available.

The YAG-40 operated in approximately a two by six mile square area 40 miles northwest of ground zero. Except for the first two hours, during which she was headed into an 8 knot wind, she was maneuvered in a figure eight. Her speed of advance was just slightly over 4 knots in order to maintain steerage. The ship was, therefore, adequately orientated during the fallout period for washdown purposes.

The washdown was turned on 35 minutes after the arrival of initial fallout, when the activity had reached 200 mr/hr. It was kept on about two hours after fallout ceased for a total period of operation of 10 hours. Fig. 2.71-4 and 2.71-5 (Project 2.71 report) show the dose rates and total dose versus time curves for the unwashed (forward stations) and washed (aft stations) areas.

The probable error of each reading in the figures based upon preliminary calibration data, is plus or minus 15%. Fig 2.10-1 is a comparison of the ratios of the average reading under the washdown with those forward in the unwashed area. A peak activity of over 6 r occurred on H+7 hours and was maintained through H+12. This activity level compared with that under the washdown which averaged 0.8 r gives an efficiency of 84% removal. At H+12 hours, the accumulated free field dose in the unwashed area was 36 r. In comparison, the dose under the washdown averaged 8 r, giving an effectiveness of 75% in dose reduction. (See Fig. 2.10-1)

Corrections for dose rate and total dose contributed by the air envelope during fallout will be applied to the values presented in Fig. 2.10-1 when they become available.

DISCUSSION - WASHDOWN

The nature of the [redacted] (Tewa) fallout material is quite similar to that for the [redacted] Zuni), i.e., heavy calcium particles, most of the activity being associated with insoluable particulate material from 100 to 200 microns in diameter. Fig. 2.71-4 and 2.71-5 show a definite distribution of activity athwartships from bow to stern. Later analysis of post shot surveys and relative wind data will be made in an attempt to rationalize this anomaly. Final calibration of the gamma-time stations may resolve these apparent differences.

Within the limits of present instrumentation error, the effectiveness and efficiency of 75 and 84% here indicated compare favorably with results observed for the [redacted] Zuni), which is the only other land-simulated shot participated in to date.

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Project 5.1 - In-Flight Participation of a B-47E Aircraft - Lt R. C. Laumann

OBJECTIVE

The objective of this project is to measure the blast, gust, and thermal effects of a nuclear detonation on an in-flight B-47E aircraft. With the recorded data, the criteria and method used in the B-47E Weapon Delivery Handbook may be verified or corrected. In addition, the project will provide basic research data for the design criteria of future USAF aircraft.

INSTRUMENTATION

Two hundred seventy three data channels were available on this shot to record bending, shear and torsion in the wing and horizontal stabilizer, thermal inputs to the aircraft, thermally induced strain, temperature measurements, and overpressure. Prior to shot participation, 97% of these channels were operating satisfactorily. There has been no newly added instrumentation since the last participation.

AIRCRAFT POSITION IN SPACE

The B-47E was flying at an absolute altitude of 35,000 feet, a speed of Mach 0.75 and on a heading of 270° at both zero time and shock arrival time. The aircraft was oriented tail to the shot; at zero time the horizontal range beyond ground zero was 26,000 feet and at shock arrival it was approximately 66,400 feet.

RESULTS

A 313°F temperature rise was measured in the 0.020 inch 24ST aluminum right aileron unpainted test panels. A 258°F temperature rise was recorded on the 0.025 aluminum unpainted right elevator.

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Gust: At shock arrival time, the gust load was 62% of limit wing bending at Station 493.0, the critical station. Bomb bay doors showed visible evidence of minor re-buckling on the same aft sections which were buckled on the [redacted] Dakota).

Overpressure: Peak overpressure measured was 0.59 psi at H+57 seconds.

58

[redacted] (TEWA)

Project 5.2 - In-Flight Participation of a B-52 - 1st Lt. F. L. Williams

OBJECTIVE

The objective of this test was to determine the delivery capability of the B-52 aircraft.

INSTRUMENTATION

Instrumentation of the B-52 for this shot consisted of 312 oscillograph channels which recorded measurements from strain-gage bridges, accelerometers, roll and pitch gyros, radiometers, pressure transducers, calorimeters, thermocouples, and control position transducers. In addition, 13 cameras recorded photorecorder instruments (14 channels), wing and tail deflection, cloud coverage, and fireball rise and growth.

AIRCRAFT POSITION IN SPACE

The following chart shows the airplane's position at zero time and time of shock arrival:

	Altitude (abs, ft)	Offset (ft)	Heading (true-deg)	Slant Distance (ft)	Velocity (fps) TAS	Velocity (fps) Ground
Condition at Time Zero	41000	1900	106	48800	762	757
Condition at Shock Arrival	41000	2750	105	91000	752	747

RESULTS

Thermal Energy: 57.7 BTU/ft^2 (14.9 cal/cm^2) measured at BS 655 by a 160° field calorimeter pointed straight down.

Maximum Temperature: 144°F measured at ES 230, lower surface. (Grey panel: absorptivity = 0.54)

Gust: 54% wing bending at LHWS 444

28% tail bending at LHSS 300

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[redacted]

Overpressure: 0.34 psi measured at BS 340, left-hand side.

Instrumentation Failures: One tail turret camera and twelve oscillograph channels failed during the [redacted] (Tewa) mission. Of the total instrumentation, 96.2% was operative.

Project 5.3 - In-Flight Participation of a B-66B Aircraft - R. W. Bachman

OBJECTIVE

The primary objective of this test was to measure the gust, thermal, overpressure and high Q field effects of a high yield megaton nuclear weapon on a B-66B aircraft.

INSTRUMENTATION

Instrumentation on the B-66B included a total of 298 recording channels consisting of strain gages, thermocouples, accelerometers, calorimeters, one radiometer and wing and tail deflection cameras. Also included in the instrumentation were 32 basic flight instruments on a photo-recorder panel and 8 correlation channels.

AIRCRAFT POSITION IN SPACE

Using the K-5 Radar and Raydist Positioning System, the B-66B was positioned at an altitude of 19,000 feet on a heading of 124° with a horizontal range of 27,250 feet at zero time. At shock arrival time the horizontal range was 65,900 feet with the aircraft on the same heading and at the same altitude as at zero time.

RESULTS

Thermal: Total thermal energy measured was 44 cal/cm^2. Maximum Δ T measured was 258°F on the 0.016 painted elevator panels, which gives a total temperature of 322°F on the elevator.

Gust: Maximum gust loading at shock arrival time was 1.68 g's (56% allowable limit on the wing using a dynamic magnification factor of 1.59).

Overpressure: Peak overpressure measured was 0.84 psi.

Operability: Of the 298 data recording channels, 97% were operable.

Damage: The only visual damage was the burning and delamination of the lower quadrant of the tail radome. This article had been coated with PV-100

[redacted]

[redacted] (TEWA)

Project 5.7 - Thermal Flux and Albedo Measurements from Aircraft -

Capt. R. L. Dresser

OBJECTIVE

The objective of Project 5.7 participation on this shot was to obtain thermal flux and albedo information of a nuclear detonation with airborne calorimeters, radiometers, and sixteen millimeter motion picture cameras.

INSTRUMENTATION

Instrumentation within the purview of Project 5.7 which was installed in the B-47 included nineteen NRDL calorimeters and two NRDL radiometers for measuring the direct and surface reflected thermal radiation. Six calorimeters were utilized to measure thermal radiation which was back-scattered toward the cockpit. Seven GSAP N-9 cameras were utilized to obtain photographic coverage of the fireball, the earth's surface, and of clouds beneath the aircraft, and also of any reflecting surface such as a cloud which could contribute to the back-scattered radiation.

Project 5.7 instrumentation on the B-52 included the twenty-one basic instruments for thermal radiation measurements, but only an additional two instruments were utilized for back-scatter measurements. Eight GSAP cameras were installed for photographic coverage.

The B-57 had no planned participation in this event.

Project 5.7 instrumentation on the B-66 consisted of the basic twenty-one instruments and twelve cameras.

Neither tactical bomber (B-66, B-57) was instrumented for measuring back-scattered thermal radiation. The twenty-one basic thermal instruments possessed various fields of view and were suitably filtered to obtain

[redacted]

qualitative spectral distribution information. All channels were recorded on Consolidated Recorders except the six back-scatter channels in the B-47 which were recorded on magnetic tape. The cameras were equipped with red and blue filters to obtain information at each end of the visible region of the spectrum. Several cameras were equipped with spectroscopic attachments to obtain continuous spectra in the visible region. Two of these spectrographs were operated at the EG&G Chieerete photo tower.

AIRCRAFT POSITION IN SPACE

Information of the position in space of each aircraft is contained in the post shot reports of the following projects:

Project 5.1 - B-47

Project 5.2 - B-52

Project 5.3 - B-66

RESULTS

Thermal: The preliminary value of total thermal input to the aircraft obtained by Project 5.7 instrumentation is included in the post shot report of the appropriate project indicated above.

Back-scatter Measurements on the B-47: All six of the back-scatter channels operated satisfactorily although the signal input to the most insensitive channel was too low to be readable. The signals received indicate an uncorrected value of from 18 to 45 millicalories for the back-scattered thermal radiation.

Photographic Data: A total of twenty-nine cameras were operated on this event. Seven of these were operated on the B-47. All seven ran and should produce usable results. Of the twelve on the B-66, one of the cameras equipped with a spectroscope failed to operate because of film breakage. All others operated satisfactorily and should produce usable

results. Of the eight cameras on the B-52 all operated satisfactorily and should produce usable results. No report has been received as yet on the operation of the two spectral cameras at the Chieerete photo tower. Further evaluation of the photographic effort cannot be accomplished until the film is developed.

[redacted] (TEWA)

Project 5.8 - In-Flight Participation of the A3D-1 Aircraft - LCDR P.S. Harward

OBJECTIVE

The objective of this test was to investigate the A3D-1 aircraft capability for the delivery of high yield nuclear weapons by the measurement and correlation of the in-flight effects of a nuclear detonation.

INSTRUMENTATION

Instrumentation of the A3D-1 aircraft consisted of 96 oscillograph recording channels, one photo recorder, four GSAP (Gun Sight Aiming Point) cameras, and three dosimeters. The data recorded included temperature rise, thermal input, rate of thermal input, overpressure, gust loading, aircraft response, engine response, and gamma radiation.

AIRCRAFT POSITION IN SPACE

The A3D-1 aircraft was flying at an absolute altitude of 36,310 feet with no offset. Aircraft was on a heading of 117°T in a tail-on position at zero time. Horizontal ranges at zero time and shock arrival time were 30,000 feet and 96,700 feet respectively. Time of shock arrival was 80.9 seconds. The A3D position was 200 feet beyond the planned zero time position.

RESULTS

Thermal: Temperature rise on the critical aircraft structure was 61-69°F (20% design limit). One 2' x 2' panel painted grey and one 2' x 2' panel painted blue received temperature rises of 132-191°F and 344-348°F corresponding to 40 and 84% design limit respectively.

Gust: Total gust load at time of shock arrival was 0.45 g's at center of gravity.

Overpressure: Peak overpressure measured was 0.31 psi at time of shock arrival (80.9 seconds).

[redacted] (TEWA)

Project 6.1 - Accurate Location of Electromagnetic Pulse Source - E. A. Lewis

OBJECTIVE

To utilize the electromagnetic signal originating from nuclear weapon detonations to determine ground zero of detonation. Secondarily, to obtain the yield data that is available in the bomb pulse.

PROCEDURE

Location of ground zero is made by use of an inverse Loran principle. The exact time the bomb pulse is received at various stations is recorded. The exact time difference in receipt of the electromagnetic pulse between two stations was used to determine a hyperbolic curve which runs through ground zero. The point of intersection of two or more curves determines ground zero.

There are two systems. One of the systems is known as the long base line system and the other the short base line system. Each system has two sets of stations. The long base line has one set of stations located in the Hawaiian Islands (Midway, Palmyra and Maui) with synchronizing antenna station at Haiku, Maui, and the other set of stations in the States (Harlingen, Texas; Blytheville, Arkansas; Kinross, Michigan; and Rome, New York) with synchronizing antenna station at Cape Fear, North Carolina. The short base lines have one set of stations located in the Hawaiian area (Kona, Hawaii; Papa, Hawaii; and Red Hill, Maui) the other set in California (Pittsburg, Woodland, and Maryville).

RESULTS

All stations in both the long and short base lines successfully received and recorded the wave form of the electromagnetic pulse emanating from the bomb detonation. Line of position and fix errors will be reported later.

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[redacted] (TEWA)

Project 6.3 - Effects of Atomic Explosions on the Ionosphere - M. Hawn

OBJECTIVE

The objective of Project 6.3 was to obtain data on the effects of high yield nuclear explosions on the ionosphere. Principally, to investigate the area of absorption, probably due to the high altitude radioactive particles, and to study the effect of orientation relative to the earth's magnetic field on F2 layer effects.

INSTRUMENTATION

The system comprised:

Two Ionosphere recorders, type C-2, operating on pulse transmission, installed in 6 ton trailer vans, one located at Rongerik Atoll and one located at Kusaie in the Caroline Islands.

One ionosphere recorder, type C-3, operating on pulse transmission, installed in a C-97 aircraft based at Eniwetok Island.

Detailed Description:

Ionosphere recorder site (Rongerik Atoll)

site (Kusaie)

AN/CPQ-7, type C-2 ionosphere recorder with a power output of 10 KW peak pulse alternately transmitting and receiving automatically over the range of frequencies from 1 to 25 megacycles. This equipment measures and records at vertical incidence the virtual height and critical frequencies of ionized regions of the upper atmosphere.

A 600 ohm multiple wire antenna designed and erected, so that the direction of maximum intensity of radiation will be at the desired vertical angle over all of the operating frequency range from 1 to 23 megacycles.

The transmitting and receiving antennas and the ground plane were in mutual perpendicular planes with the plane of the transmitting antenna oriented 53° to the east of magnetic north.

Ionosphere recorder site (C-97 aircraft)

Same as for Rongerik and Kusaie, except that a C-3 ionosphere recorder was used. This recorder is the same as the C-2, except for a few modifications and improvements.

The transmitting antenna in the C-97 was a single wire delta fastened to the lateral extremities of the tail assembly.

METHOD OF OPERATION

Kusaie

16mm camera: Routine until H-5 hours and 16 minutes; thence continuous until H+18 hours and 44 minutes; thence routine.

35mm camera: Routine until H-15 minutes; thence once a minute until H+8 hours; thence routine.

Rongerik

Routine until H-15 minutes; thence once per minute until H+8 hours, thence routine.

C-97

Routine operation until H-15 minutes using 30 second sweep; thence continuous until approximately H+5 hours.

RESULTS

All stations operated successfully for this shot.

Recorded data from all stations will not be available for review until a later date.

[redacted] (TEWA)

Project 6.4 - Determination of Characteristics of Airborne Flush Mounted Antennas and Photo Tubes for Yield Determination at Extended Ground-to-Air Ranges - A. J. Waters

OBJECTIVES

To determine the effectiveness of flush mounted airborne antennas and phototubes at various ground-to-air ranges in detecting characteristic low frequency electromagnetic radiation and visible radiation, respectively.

To determine the temporal and amplitude characteristics of the low frequency electromagnetic radiation at various ground-to-air ranges.

To determine the temporal and intensity characteristics of visible radiation at various ground-to-air ranges.

To determine the effects of ambient conditions upon the satisfactory measurement of the parameters specified in the first two items.

INSTRUMENTATION

2 fiducial antennas	2 scope cameras
1 whip antenna	1 sequence camera
1 synchronizer	1 recorder
2 photoheads	

2 DuMont Scopes (1 a dual beam, 1 a single beam)

TECHNIQUE

Signal is received by antenna fed through an amplifier and then to the scope. The signal is then photographed. Photohead output is led directly to the recorder. The sequence camera photographs the blast directly for use in correlation of previous data. Distance was approximately 92 miles.

RESULTS

Signal was received and recorded from both antennas. Trace was compressed so it was possible to see not only the beginning but the entire signal. Photohead data was obtained on both channels (photoheads). No signal was obtained on the whip antenna.

[redacted] (TEWA)

Project 6.5 - Analysis of Electromagnetic Pulse Produced by a Nuclear Explosion - Charles J. Ong

OBJECTIVE

The objective of Project 6.5 was to obtain waveforms of the electromagnetic radiation for all the detonations during Operation REDWING. This data is to be used in connection with a continuing study relating the waveform parameters to the height and yield of the detonation.

INSTRUMENTATION

Two identical stations were used to record data, one at Eniwetok and one at Kwajalein.

The instrumentation consisted of a wide-band receiver with separate outputs connected to each of the three oscilloscopes. Mounted on each oscilloscope was a Polaroid Land Camera for recording the transient display.

The wide-band receiver consisted of one primary and four secondary cathode follower amplifiers. An antenna, frequency insensitive in the range of interest was fed directly into the primary cathode follower. The primary cathode follower was then connected to four individual cathode followers by a 50-ohm coaxial cable. Only three secondary cathode followers were utilized, the fourth serving as a spare.

The number one and two cathode followers fed oscilloscopes with sweep speeds of approximately 30 microseconds per centimeter and 10 microseconds per centimeter respectively. The number three cathode follower was connected to the third oscilloscope through a 2 microsecond delay line. The third

oscilloscope had a sweep speed of 1.0 microseconds per centimeter. All oscilloscopes were triggered simultaneously by the DC trigger device located in the primary cathode follower and connected directly to the receiving antenna. The 2 microsecond delay line was added to permit the leading edge of the waveform to be recorded.

In order to establish a definite time relationship between the reception of the signal and the triggering of a given device such as a counter or transmitter, a time marker pip, generated by the delay trigger from one of the oscilloscopes, was fed through the 2 microsecond delay line and superimposed on the initial portion of the received waveform.

PROCEDURE

All oscilloscopes were calibrated against a known frequency standard for sweep linearity.

The cathode follower triggering system was set to trigger approximately 6 decibels above the noise level. The vertical deflectors of the oscilloscopes were set to receive the predicted field strength.

RESULTS

Station A - Parry Island

Data was recorded on all oscilloscopes.

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Station B - Kwajalein

This station operated satisfactorily. No results are obtainable at this date.

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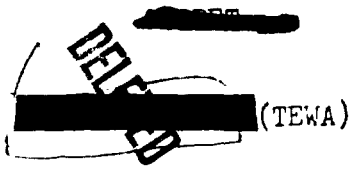

Project 9.1 - Technical Photography - J. G. James

Three RB-50 aircraft were scheduled for this event. Carter II normally positioned in the south quadrant, aborted the mission at 0300 due to mechanical difficulties. This abort was made prior to take off. Carter III was repositioned from the west quadrant to replace Carter II in order to insure triangulation photography. At completion of mission both aircraft commanders reported excellent photographic conditions from zero time to plus 45 minutes. Both aircraft completed three race-track photo runs. Carter I encountered light cloud cover at 20,000 feet at plus nine minutes. Because of this probable obscuration plus low ambient light levels at this time decision was made to return to the original zero starting point. This change in flight plan should not materially affect the overall qualitative results of the mission. No camera malfunctions were reported and final results are expected to be good.

Carter I proceeded to Enyu Island and conducted a damage survey. Observers reported no apparent water or blast damage visible on the island. At plus 2 hours Carter I approached the ground zero area from the south quadrant to attempt a crater survey. One mapping run was made at 1700 feet, the mission was aborted when the aircraft entered a 12 r/hr level; however it is possible the exposed negatives may cover the critical area as defined in the mission requirement.

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[redacted]

PART III

TASK UNIT 1

LASL PROGRAMS

Keith Boyer

Keith Boyer
Advisory Group

Program 16 - Physics & Electronics & Reaction History — B. E. Watt

[redacted]

13

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[redacted] (TEWA)

Project 16.3 - Electromagnetic Investigations - R. Partridge

Project 16.3 measures the time interval [redacted]

DELETED

[redacted]

No alpha measurement was attempted because of the over-the-horizon transmission path from the device to the recording station.

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[redacted]

PART IV

TASK UNIT II

UCRL PROGRAMS

W. D. Gibbins
Dep for UCRL

Program 21 - Radiochemistry	R. H. Goeckermann
Program 22 - History of the Reaction	L. F. Wouters
Program 23 - Scientific Photography	H. B. Keller

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[redacted] (TEWA)

Project 21.1 - Radiochemical Analysis - R. Goeckermann

Fission yield

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[redacted] (TEWA)

Project 21.2 - Sampling - R. Batzel

The Air Force Special Weapons Center supplied two F-84G and four B-57 aircraft to take samples. An additional B-57 was supplied as control plane.

Aircraft	Time after shot Hours	Alt Collected Thousand Feet	Fission One Wing	Pilot Radiation mr
055	1.30 - 1.40	33	10×10^{15}	2,265
046	1.45 - 1.50	43.5	5.8×10^{15}	2,385
501	2.00 - 2.15	52	5.6×10^{15}	3,097
502	2.15 - 3.00	47 - 48	12×10^{15}	2,480
496	2.30 - 3.10	53	10.7×10^{15}	3,230
495	3.20 - 3.45	53.5	6.7×10^{15}	1.720

The cloud on [redacted] (Tewa) topped at about 95,000 feet and the base was at 30,000 feet.

The samples collected were large enough to perform all necessary measurements on this device. The success of this project was due to the interest and help given by the men assigned by the Air Force.

[redacted]

DELETED

[redacted]

DELETED

[redacted] (TEWA)

Project 22.2 [redacted] - H. Grier

E. C. Woodward

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[redacted] (TEWA)

Project 22.3 - High Explosive Transit Time - C. E. Ingersoll

E. C. Woodward

The technique used for measuring the high explosive transit time consisted of telemetering signals from signal sources in the immediate neighborhood of the [redacted] (Tewa) device by high frequency radio-frequency methods to a receiving and recording station located near and in Station 70 on Enyu. The signals were then recorded on oscillographs.

The signal sources were the load ring pulse of the X-unit and the output of a fluor - phototube detector which measured the gamma rays from the nuclear reaction.

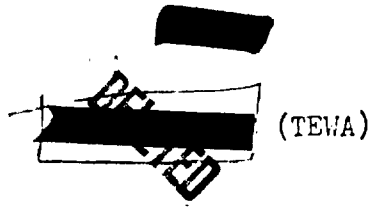
The oscillograph displays consisted of a raster scope containing both signals and an oscilloscope with a Rossi presentation of the gamma ray flux measured by the fluor - phototube detector.

The results of the measurement are as follows:

[redacted]

[redacted]

41



Project 23.1 - Fireball and Bhangmeter - H. E. Grier

D. Berkowitz

FIREBALL

Preliminary fireball measurements were made on five Eastman high speed films, two each from stations Enyu and Bikini, and one from Chieerete. The results are:

Enyu	ϕ=234.8	4.99 MT
Enyu	ϕ=233.6	4.87 MT
Chieerete	ϕ=235.4	5.06 MT
Bikini	ϕ=235.8	5.10 MT
Bikini	ϕ=239.8	5.50 MT

The fireball visibility was good from all stations; there were only a few scattered clouds. The assumed ambient air density used in these calculations was 1.10 grams/liter. The fireball images on the second film from Bikini were definitely of poor quality, and the corresponding yield is weighted very little in computing the average.

The average yield is 5.01 megatons ± 4%.

BHANGMETER

Four Bhangmeters at the control point indicated a time to minimum of 224 milliseconds which corresponds to a yield of 5.0 megatons.

[redacted]

Use Graphic Arts
Neg # 560233

Fig. 23.1-1

43

[redacted]

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[redacted]

Use Graphic Arts
Reg # 560231

Fig. 23.1-2

[redacted]

4

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[redacted]

Now Graphic Arts
Req #560230

Fig. 23.1-3

[redacted]

[redacted]

Mesa Brightline Arts
Neg # 560232

Fig 23.1-4

[redacted]

[redacted] (TEWA)

Project 23.3 and 23.4 - Time Interval and Time and Pressure Measurements -

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[redacted]

[redacted]

BRIEF DESCRIPTION OF THE INSTRUMENTATION - PHOTO BUNKER

All of the observations for this experiment were made with Model 100 streaking image cameras. These were located at Station 1528, some 32,000 feet from the device. No difficulties in the operation of the cameras were encountered. Aside from the loss of film speed in the warm and humid atmosphere of the bunker and alignment problems on a small target at six miles, everything behaved exactly as planned.

PRELIMINARY CONCLUSIONS

DELETED

[redacted]

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